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CONDITIONS UNDERLYING THE INFECTION OF WOUNDS.[1]

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That the presence of certain kinds of bacteria is an essential condition of wound infection is a fact so well established, and so generally recognized, that no discussion as to this point is likely to arise in this assembly. The practical results of the application of this doctrine to the management of wounds are the most eloquent testimony to its life-saving truth. The recognition of this truth, even before its complete demonstration, and the introduction of methods of wound treatment based upon it, will remain the immortal merit of Lister, even although every detail of his treatment be replaced by measures found by riper experience to be better suited to the purpose.

The simple conception which was the basis of early antiseptic procedures in surgery—that a wound to which bacteria gain access becomes infected in the same way as a sterilized infusion of meat undergoes putrefaction when a single suitable germ enters—has been greatly modified. Furthermore, it is found that the traumatic infections present their own peculiar problems, which must be studied by themselves, and

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The full title of the subject proposed for discussion was: "Conditions Underlying the Infection of Wounds: including a Discussion of Disinfection with Reference to Treatment of Wounds, of the Relation of Bacteria to Suppuration, of the Resistance of Tissues to the Multiplication of Bacteria, and of the Effects of Antiseptic Agents on Wounds."

cannot be solved by analogies drawn from observations of other specific infections, such as anthrax and the septicæmias of the lower animals. The study of wound infections involves the consideration of many varying and often complicated factors, relating both to the agents of infection and to the individual exposed to infection.

Without consuming time with any historical review, I shall proceed at once to indicate some of the questions which are of especial importance, and which may be profitably considered in this discussion.

What are the microörganisms concerned in the infection of wounds, and how do they act?

How are we to explain the great differences in the effects produced by the pyogenic bacteria, their apparent harmlessness under some conditions, their fatal virulence in others?

What are the ways by which bacteria gain access to a wound?

How often are bacteria to be found in wounds treated antiseptically or aseptically? What are the characters of these bacteria and whence do they come?

What are the best means of surgical disinfection?

No attempt can be made on this occasion to treat exhaustively a single one of these questions. My aim will be to present a brief survey of our knowledge, as well as of the defects in our knowledge, concerning some of the more important questions; to offer some results of personal observation and experiment, and to indicate in conjunction with the Co-referee the lines which this discussion may follow. It does not seem necessary, indeed it would be presumptious before this audience, to dwell in detail upon established facts which are the common property of all who are interested in the subject.

So far as personal observations and experiments are concerned, I may say that these have been made in the Johns Hopkins Hospital and Pathological Laboratory, and that I am indebted to several of my colleagues and co-workers there for work which they have done either independently or under my supervision. I take this opportunity of acknowledging especially the assistance of Drs. Halsted, Abbott, Ghriskey, Robb, and Howard.

This paper will relate only to the ordinary inflammatory and suppurative traumatic affections, and not to specific wound infections, like tetanus, diphtheria, and hospital gangrene.

It would be wearisome on this occasion to consider or even enumerate all the bacteria which have been found in suppurative and other traumatic inflammatory processes, so that in this connection I shall touch only upon a few points drawn chiefly from our own experience.

We have found the staphylococcus pyogenes aureus far more frequently than any other species of bacteria in furuncles, abscesses, osteomyelitis, and other forms of suppuration. The prevalence in Strassburg, accord-

ing to Levy, of the staphylococcus pyogenes albus in all kinds of suppurative inflammation (excepting furuncles), raises the question whether there may not be differences in different regions as regards the relative frequency of the various kinds of pyogenic cocci.

We have, however, met a white staphylococcus in a certain class of cases with great frequency, viz., in small stitch abscesses, and in the slighter grades of inflammatory disturbance of wounds treated antiseptically or aseptically. This coccus has been often seen by Bossowski and others in the same class of wounds, and has been hitherto identified with the staphylococcus pyogenes albus of Rosenbach, but we have some hesitation in so regarding the micrococcus which we have found in the cases mentioned. The staphylococcus pyogenes albus is generally described as not differing essentially from the aureus, except by the absence of the yellow color in the cultures. This coccus, however, differs from the staphylococcus pyogenes aureus in much greater slowness of liquefaction of gelatin and of coagulation of milk, and in far less virulence when inoculated into the circulation of rabbits. It may be an attenuated form of the staphylococcus pyogenes albus. Until this is settled I propose to call it the staphylococcus epidermidis albus, as it is an almost constant inhabitant of the epidermis, as will be apparent when I come to speak of the bacteria in aseptic wounds. I shall only add here that this coccus may be present in graver suppurative inflammations, but then it has been nearly always associated with some other pyogenic organism, or has assumed the form of the typical staphylococcus pyogenes albus.

It is, perhaps, not out of place to remark that the diagnosis of the staphylococcus pyogenes albus in cultures from abscesses and other suppurations should not be made too hastily. It may require several days before colonies of the aureus assume a distinct yellow color. Cultures upon potato are particularly favorable for the speedy development of this color. There may be marked differences in the rapidity with which different colonies of the aureus from the same source and in the same plate or roll cultures turn yellow.

The efforts to differentiate into distinct species the pathogenic streptococci have thus far met with little success, so that the weight of opinion favors the view that the streptococci of erysipelas, of phlegmonous inflammations, of septicæmia, of puerperal fever, and of various forms of angina, belong to one and the same species. In conformity with the results of most investigators I have been unable to determine any decisive differences between the streptococcus erysipelatus and the streptococcus pyogenes. Von Lingelsheim has recently divided the streptococci into two groups: one non-pathogenic, called the streptococcus brevis, and the other pathogenic, the streptococcus longus. Among the points of distinction which he gives there is one which I have not found constant,

viz., the invisible growth of all pathogenic streptococci upon potato. The behavior is usually as stated by Von Lingelsheim, but I have isolated from a case of phlegmonous cellulitis, and from one of septicæmia, a streptococcus presenting a distinct grayish-white growth upon potato. Von Lingelsheim made no use of one of our most valuable differentiating media, viz., sterilized milk colored with litmus. In this medium the common streptococcus pyogenes produces a very firm coagulum with separation of nearly colorless serum, as has been pointed out by E. Fränkel. I have from different sources isolated pathogenic streptococci which do not coagulate milk, although they change the color of the litmus to a lilac pink, indicating the production of a certain amount of acid.

While we must admit that all inflammatory affections caused by the pyogenic staphylococci may be produced also by streptococci, and, with the probable exception of erysipelas, the reverse also holds true, nevertheless we are not prepared to accept the statements of Levy and some other recent writers that the character of the microörganisms, whether staphylococci or streptococci, has no influence upon the symptomatology of the disease. In conformity with most investigators, we have found the staphylococci prone to form circumscribed areas of suppuration, whereas the pyogenic streptococci have a tendency to produce spreading phlegmons with lymphangitis and a wide zone of surrounding redness and inflammatory œdema. It is the custom in our gynecological wards to isolate the operative cases in which streptococci are found at the time of the operation in the seat of the disease, or subsequently in the wound.

Of other pyogenic cocci we have found the staphylococcus pyogenes citreus twice in abscesses, the staphylococcus cereus albus three times in combination with other bacteria in suppurating wounds, the diplococcus pneumoniæ once in a fibrinous peritonitis, and the micrococcus tetragenus once, together with the staphylococcus aureus in an abscess of the lung.

The list of bacilli which may be concerned in suppurative and other inflammatory affections is much longer than was formerly supposed, and is likely to be still further extended. Those which we have chanced to encounter are: the bacillus pyogenes fœtidus, twice in abscesses containing bad-smelling pus; the proteus Zenkeri, once in pure culture in an ovarian abscess with purulent salpingitis; a bacillus apparently identical with the bacillus emphysematis maligni of Wicklein, once in an emphysematous cellulitis of the arm; a bacillus apparently identical with the bacillus enteritidis of Gärtner, in the brain and other organs of an infant three months old with cerebral abscess and meningitis following operation for imperforate anus; the typhoid bacillus, once in pure culture in an osteomyelitis of the ribs following typhoid fever: a hitherto undescribed bacillus, rapidly liquefying gelatin and characterized by rapid solution or peptonization of milk, without coagulation, once in peritonitis; bacilli

which could not be cultivated in our ordinary culture media, in three cases of suppurative inflammation; and the bacillus coli communis, fifteen times.

As these bacillary infections are far less common than those caused by micrococci, I shall take some other occasion to describe them, and here shall ask your attention only to one group, viz., those associated with the bacillus coli communis, as they have been relatively common in our experience and present some points of especial interest.

The first observation of the bacillus coli communis in connection with wound infection was made by Tavel, in 1889. This has been followed by a few isolated observations of this organism either in the unchanged organs of the body or in abscesses, until recently A. Fränkel reports its presence in nine out of thirty-one cases of peritonitis. I first came across this bacillus in the organs of the body in 1889, in a case of multiple fat-necrosis with pancreatitis, which I reported to the Association of American Physicians. As in this case diphtheritic colitis existed, it seemed probable that the lesion of the intestine opened the way for the entrance into the circulation of this inhabitant of the healthy intestinal canal. This view subsequent experience has confirmed, for I have already isolated in pure culture from the internal organs the bacillus coli communis in twenty-five autopsies where some distinct lesion of the intestinal mucous membrane existed, such as ulceration, diphtheritis, hemorrhage, traumatic injury, and I have almost uniformly failed to find it outside of the intestine when no demonstrable lesion of the mucous membrane existed. I am therefore prepared to say that this bacillus is an extremely frequent invader in intestinal disease, although I have no evidence to offer that it does any harm except under certain especial conditions. The autopsies were in nearly every case made within three or four hours after death, once in less than one hour. Moreover, the colon bacillus does not invade the blood and organs in the process of post-mortem decomposition.

The cases in which we have found the colon bacillus under circumstances pointing to its pathogenic action have been as follows: perforative peritonitis, four cases; peritonitis secondary to intestinal disease without perforation, two cases; circumscribed abscess, three cases; and laparotomy wounds, six cases.

Its presence, several times in pure culture, in laparotomy wounds treated aseptically, although apparently not a source of serious trouble, was not a matter of indifference. It was generally accompanied with moderate fever and a thin, brownish, slightly purulent discharge, of somewhat offensive, but not putrefactive odor. The smooth and rapid healing of the wound was interfered with. In some of the cases there was evidence of intestinal disorder; in others this was not apparent, and infection from without could not be excluded.

For the purposes of the present discussion, perhaps the chief interest of our observations concerning the colon bacillus is that they furnish an illustration of the possible predisposition to infection afforded by intestinal lesions, and also give an example of the much-disputed auto-infection.

Of suppurative inflammations which we have examined bacteriologically with negative result, may be mentioned abscesses in which the bacteria were presumably dead, several hepatic abscesses caused by the amœba dysenteriæ, and many cases of suppurating buboes and of pyosalpinx, doubtless caused by the gonococcus.

From the foregoing brief summary, mainly of our own limited experience, it is clear that the bacteria which may be concerned in surgical infections are many, but the pyogenic cocci of Ogston, Rosenbach, and Passet far out-rank in frequency, and therefore in importance, all other bacteria combined.

In view of the more practical matters to be considered, we cannot tarry long over the theories of suppuration, interesting as just this part of the subject is at the present time.

There are very good reasons to believe that the process of suppuration serves a useful purpose, and is one of the most important and efficient weapons employed by Nature in combating invading microöganisms. Man is not subject to those forms of septicæmia, common in many lower animals, in which enormous numbers of bacteria are present in the blood; but, on the other hand, he is particularly subject to suppurations and other localized inflammations. The same microörganism, for instance the diplococcus pneumoniæ and the bacillus anthracis, which produces in many of the lower animals the form of septicæmia mentioned, causes in man localized inflammations. In the experimental septicæmias of lower animals there is an unmistakable relation between the extent of the local reaction at the point of inoculation on the one hand, and the duration of life and number of organisms present in the blood on the other. The more extensive and intense the local reaction, the fewer, as a rule, are the bacteria found in the blood and the longer the duration of life. There are two varieties of the swine-plague bacillus, the one kills rabbits in twelve to eighteen hours with trifling local reaction and a large number of bacilli in the blood, the other produces extensive purulent infiltration around the site of subcutaneous inoculation and permits the animals to live for several days, and at the autopsy very few bacteria are found in the blood. In a susceptible animal the virulent anthrax bacillus produces an acute septicæmia, the attenuated bacillus a local abscess. There is even experimental evidence that if inoculation of a susceptible animal with the virulent anthrax bacillus be speedily followed by inoculation at the same point with a pyogenic organism so that suppuration soon ensues, the development of anthrax

septicæmia may be warded off and the animal recover. It seems reasonable to infer, when the same organism produces in one animal a rapidly fatal septicæmia without local reaction and in another species only a local abscess, that the latter animal is protected by the barrier of suppuration. As is well known, the fatal infections from wounds received at post-mortem examinations are not generally those where marked local reaction with suppuration appears at the seat of the often trifling injury.

Exactly how abscess formation checks the invasion of bacteria we do not know. That bacteria may die, often in a short time, in pus both within and outside of the body, has been demonstrated. The leading theories are these: leucocytes and other cells act as phagocytes, taking into their bodies the bacteria and killing them; the wall of leucocytes and other cells at the margin of an abscess acts as an obstacle to the passage of the bacteria into the surrounding tissues; pus contains chemical substances injurious to bacteria or antidotal to their toxic products; the bacteria starve in pus, not being able to assimilate such concentrated food. Something can be said in favor of each of these theories, more in favor of some than of others, but none is proven and we cannot stop to discuss them here.

That pyogenic bacteria set up suppuration by chemical substances produced by them, seems to be proven. The zone of necrosis around these bacteria which can be demonstrated as the first effect of their lodgment in the tissues points to such chemical action. Moreover, from cultures of pyogenic cocci several chemical products have been obtained capable of causing suppuration. The most interesting observations here are the recent ones of Buchner and his pupils, who have found the proteid constituents of many bacteria capable of producing suppuration. These bacterio-proteins of Buchner possess in a remarkable degree the property of positive chemotaxis, that wonderful quality by which certain chemical substances influence the leucocytes to migrate from the vessels and move actively toward them. A flood of unexpected light seems destined to come from the studies of chemotaxis to illumine many dark problems in pathology.

Since we know that the chemical products and constituents of certain bacteria are the direct agencies in the production of suppuration, it is less surprising to find that various other chemical substances are likewise able to cause suppuration. But important as this fact is for the theory of suppuration, the demonstration that these other chemical irritants, such as turpentine, nitrate of silver, etc., can cause suppuration has no especial bearing upon the ordinary suppurations in human beings.

We come now to the consideration of a division of our subject beset with difficulties at every turn, but one no less interesting to the surgeon than to the bacteriologist.

How are we to explain the extraordinary variability in the effects produced by the pyogenic cocci? The specific infectious agents with which we first became familiar, the bacteria of the natural and of the experimental septicæmias of lower animals, are nearly constant in the effects which they produce when inoculated in small quantity into susceptible animals. Not so with the pyogenic cocci. Here we meet the most puzzling differences. We find the same coccus in the most insignificant epidermal pustule which we find in a dangerous phlegmon, in osteomyelitis, in pyæmia, in septicæmia, in acute ulcerative endocarditis. The manifold varieties of puerperal fever, which we now know to be a typical wound infection, may be caused by apparently the same streptococcus, producing a mild endometritis, a pelvic abscess, localized or general peritonitis, pyæmia or the most virulent and rapidly fatal septicæmia.

If we seek an explanation of these things by experimentation upon animals, we find that in order to get any positive effects at all it is often necessary to introduce enormous quantities of our cultures, containing vastly more bacteria than we can suppose to be concerned in the primary infection in human beings. If we inoculate smaller quantities, these can often be disposed of by the animal without any manifest symptoms.

It must be confessed that we stand here before problems many of which still await solution, but it will not do to pass them by on this occasion without some discussion, although time will permit me to touch upon only some of the salient points.

It is well to bear in mind that the inflammatory infections of wounds do not represent specific morbid entities in the same sense as do anthrax and typhoid fever, for example. The latter diseases are caused by a single specific germ and no other, and present a definite and characteristic clinical and anatomical picture, whereas the former correspond to the reaction of the body toward a great variety of noxæ and offer manifold variations in symptoms and lesions.

The quantity of a culture of the staphylococcus aureus required to produce suppuration is not the same for all tissues and all parts of the body. A mere trace, a fraction of a drop, of a dilute suspension of the yellow staphylococcus in salt solution when injected into the rabbit's eye will set up a suppurative inflammation. It takes a larger amount of such a suspension to produce an abscess in the loose subcutaneous tissue of the back than in the dense tissue of the ear of a rabbit. Enormous quantities, five to ten cubic centimetres and more, of the suspension can be injected often without effect into the normal peritoneal cavity of rabbits and dogs, as has been shown by the well-known experiments of Grawitz and his pupils, confirmed by several other investigators.

It is probable, as claimed by Grawitz, that this difference in the behavior of different tissues depends in large part upon the rapidity with which the injected material, more particularly the toxic substances, are absorbed. But we must also reckon with a predisposition apart from this in the normal tissues, for the introduction even of very large numbers of staphylococci into the circulation of rabbits is followed by the formation of abscesses only in certain situations, mainly the kidneys, heart and certain muscles, although we must suppose that the cocci have been carried to all parts of the body.

That there are variations in the virulence of different cultures of the pyogenic cocci is admitted by most writers and may be inferred from the discrepant results of various experimenters as regards the amount of the culture required to produce suppuration. These discrepancies cannot be explained wholly by different conditions of the experiments. We have found no especial difference in the result, for example, whether we introduced into the peritoneal cavity of dogs cultures of the staphylococcus aureus according to Grawitz's method, or according to Pawlowsky's method, or by a small laparotomy wound. By one as well as by another method we were able to inject 5 c.c. and often more of a suspension in salt solution of the yellow staphylococcus without any appreciable effect.

In order to test this matter of varying virulence, I have injected into the ear-veins of rabbits bouillon cultures, forty-eight hours old, of the staphylococcus aureus obtained from many different sources. Considerable variations in virulence were found to exist both in the original cultures and in the successive generations of the same culture. The most virulent culture was one from a beginning furuncle. The injection of 0.1 c.c. of this culture caused the death of the rabbit in twenty-four hours with a large number of staphylococci in the blood and many necrotic foci in the kidneys. After the second generation the virulence was lessened. From a case of hypertrophic cirrhosis of the liver without suppurative complications a moderate number of colonies of the staphylococcus pyogenes aureus were found in cultures made from the liver. 1.5 c.c. of bouillon cultures, forty-eight hours old, of this staphylococcus were injected without any effect into the ear-veins of two rabbits, the animals being still alive eight months after the injection. These extremes are met only exceptionally. In the great majority of cases we have found the injection of 0.2 to 0.3 c.c. of bouillon cultures sufficient to kill the animal in four to seven days with the usual abscesses in the kidneys and heart and occasionally elsewhere. As a rule there was no material change in the degree of virulence for many successive generations, but sometimes without any apparent cause there would occur a marked weakening of the virulence either after a few generations or after many.

Our conclusions from these experiments are that while variations in virulence occur and may explain in large part the varying results of different experimenters operating upon animals under similar conditions, they are not sufficient in degree or in frequency to afford adequate explanation of the great differences in the effects of the pyogenic cocci upon human beings, or at least can do so only in part.

How far can we apply to human beings the experiments showing the great tolerance of animals toward the pyogenic cocci? The experimental evidence upon this point is naturally scanty, but such as we possess indicates that man is not equally tolerant, that his tissues respond more readily by suppuration to inoculation of pyogenic cocci. The experiments upon this point of Garré, Bumm, Bockhart, Fehleisen, Waterhouse—and these names should not be mentioned without expressing the debt of gratitude which science owes to them—are too well known to necessitate here any statement of their results. But while these experiments appear to indicate less immunity on the part of human beings toward the ordinary staphylococci of suppuration—a matter, however, which cannot be considered absolutely certain—they have also demonstrated that the difference, if it exists, is only one of degree, and that large numbers of the pyogenic cocci may be inoculated into human tissues without effect. Waterhouse, for example, injected under the skin of the abdomen and of the scrotum 0.25 c.c. of a suspension of the staphylococcus aureus, made by mixing one loopful from an agar culture with 5 c.c. of water, and the result was completely negative.

It is true that undue emphasis should not be laid upon the negative results, for there are equally trustworthy experiments with positive result, showing that even small quantities of suspensions of the pus organisms may cause suppuration, both in animals and in human beings.

That there exist bacteria capable of producing abscesses regularly, even when inoculated in very small quantity into animals, is proven by the discovery by Dr. Bolton of a hitherto undescribed bacillus in garden earth. This bacillus, for cultures of which I am indebted to Dr. Bolton, who will hereafter publish its description, produces with certainty localized abscesses when inoculated in small amount into the subcutaneous tissues of rats, mice, and rabbits. When injected into the circulation it causes multiple abscesses in the kidneys, joints, bones, and other situations.

Inasmuch as it is by their toxic products that the pyogenic bacteria do injury, it is not surprising to find that it makes a great difference in the result whether these bacteria enter the tissues already equipped with a reserve force of this poisonous material, or must begin the fight unarmed. There is abundant experimental evidence to show that even

in very small number the pus-producing micrococci will cause suppuration if they are accompanied, or soon preceded or followed, in sufficient amount and concentration by various toxic substances which are present in pure cultures of the cocci, and the extent of the inflammation bears a relation to the quality and quantity of these substances. The experiments and researches of many investigators, such as Hankin, Brieger and Fränkel, Buchner, Dirckinck-Holmfeld, Grawitz, Leber, Dubler, Kronacher, Ribbert, have shed light upon this subject. It would seem as if the issues of the battle between the invading micrococci and the tissues depend often upon the first blow; and if the invader can strike this with the aid of powerful weapons which he has forged before he enters, the victory, for the time at least, is with him.

This matter of accompanying toxic substances is probably of great importance in our understanding of the potentialities of the living agents of wound infection as they occur under natural conditions. Here we have to do, not with pure cultures of the pyogenic cocci, still less with those that have been washed in sterilized salt solution or water, but with pus-producing organisms which have come from all sorts of sources, which have been engaged in very different activities, which have been growing under various conditions or have been long dormant, and which are mixed with many kinds of bacteria. There is proof that under some of these conditions the infectious material may possess a degree of virulence with which we are not familiar in our artificial cultures. When a strong, healthy man (I have now in mind such a case in a medical student) dies in a few days from septicæmia caused by the inoculation of a mere scratch on the finger with fluid from a puerperal peritonitis, it is the quality of the infectious material which brought about the fatal result, and not any especial predisposition of the individual. When we find, as has been done, that the peritoneal fluid contains in pure culture the streptococcus pyogenes, and that the same organism is present in pure culture in the patient accidentally infected with this fluid, the observation is just as convincing and clear in its interpretation as if the experiment had been made intentionally upon an animal. No number of experiments showing that millions of apparently the same species of micrococcus can be injected in artificial cultures into the peritoneal cavity of dogs and rabbits can do away with the force of such an observation. No surgeon, no obstetrician, however strong may be his trust in the germicidal power of the animal tissues and fluids, would willingly permit the smallest particle of that peritoneal fluid to come into contact with a fresh wound or the uterus after childbirth.

The differences in virulence which have been found to exist between inflammatory exudates from various sources containing pyogenic bacteria are much greater than those observed in the cultures of the same bacteria on artificial media. To explain this, some assume that the differences in

virulence pertain to the pyogenic cocci as such, that they are specifically endowed with different biological attributes; while others think that the varying virulence relates not so much to the bacteria as to the character of the toxic substances with which they are associated. In favor of the latter view, which is the one advocated by Bumm, Fehleisen, Chantemesse, and others, may be cited such observations as that of Bumm, who found that the injection into the peritoneal cavity of a rabbit of a quarter of a drop of fluid from a case of acute septic puerperal peritonitis quickly killed the animal with peritonitis, whereas the streptococci artificially cultivated from the same fluid were much less virulent; or the experiment of Fehleisen, showing that a minimal quantity of an artificial culture of the staphylococcus aureus added to a little of the clear serum obtained from the germ-free zone of inflammatory œdema around a spreading cellulitis was capable of producing extensive abscesses, whereas the mixture of the same organism with water had no such effect. The question is still an open one, and very likely both factors are concerned.

We have thus far confined our attention to the microörganisms of infection, and have said nothing concerning the conditions predisposing to infection in the exposed individual. Everybody believes in the doctrine of predisposition, some more than others. The tendency at the present time is certainly not to minimize its importance. Predisposition is a term to conjure with. It is often made to explain in a vague sort of way things which we do not understand. Nevertheless it is a very real thing, and we cannot pass it by here without notice, even if this must necessarily be very brief. Every surgeon knows that wounds in some persons do much better than in others, and that some kinds of wounds are much more prone to suppurate than others.

The interesting studies upon immunity which have shed so much light upon the nature of predisposition toward some infectious diseases have not as yet cleared up the question of immunity against the pyogenic cocci. We know that the healthy tissues can dispose of a certain number of these cocci under ordinary circumstances, but how they do it we do not know.

An experiment of Roger is suggestive. He found that the streptococcus of erysipelas grew as well in the blood-serum of rabbits rendered immune as in the blood-serum of other animals, but that in the former they lost their virulence. As we now know that the protective influence of the blood-serum of immune animals consists quite as much in the power to destroy the poisons produced by bacteria as in the power to kill the bacteria directly—already demonstrated examples of this are diphtheria, tetanus, and septicæmia produced by the diplococcus pneumoniæ—it is not unreasonable to suppose, in the light of Roger's experiments, that this antidotal capacity of the blood and animal fluids may

be one of the means employed by Nature in disposing of the pyogenic cocci. That these cocci are not directly killed by the extra-vascular blood-serum of rabbits, dogs, swine, and human beings, or if at all in very small number, we know. On the other hand, this serum is an excellent medium for their growth. But if the toxic products of the bacteria are destroyed by the fluids of the body, the bacteria can do no harm, and are at the mercy of the tissues, as has been shown by the recent brilliant researches of G. and F. Klemperer on the diplococcus of pneumonia. When we have a clearer insight into the nature of immunity against the pyogenic bacteria, our understanding of the conditions underlying the infection of wounds will be greatly advanced.

I cannot undertake to discuss all the general conditions of the body, such as diabetes, syphilis, alcoholism, anæmia, obesity, typhoid and other fevers, Bright's disease, etc., which have been regarded as predisposing causes of infection with the pyogenic cocci, some of these diseases upon most conclusive clinical evidence. Gärtner has recently brought forward evidence derived from experiments on animals showing that general anæmia and hydræmia render easier the infection with small quantities of the staphylococcus aureus, and Ribbert has demonstrated that the presence of toxic products of the same microörganism in the circulating blood favors the development of foci of suppuration, a fact which evidently bears upon the pathology of pyæmia and of some cases of furunculosis, as well as upon the importance of evacuating pus. An instance has already been given of the predisposition to infection afforded by intestinal lesions. In dismissing thus hastily the matter of general predisposition to suppuration, it will not be understood that these few words are a measure of the importance of the subject. I believe that the surgeon cannot be too thorough in the examination, before contemplated operations, of all the important organs and functions of the body, and that, wherever possible, he should endeavor to put the patient into the best possible condition of health before undertaking a severe operation.

Of very immediate practical interest to the surgeon is a knowledge of the various conditions in and about a wound which favor the lodgment and development of pyogenic bacteria. In a general way it may be said that anything which interferes with the integrity of the living tissues in a wound is a predisposing cause of suppuration, in case suitable microorganisms gain entrance. Experiments have shown that the necroses produced by chemical irritants, such as carbolic acid and corrosive sublimate, favor the multiplication of the microörganisms of suppuration. Dr. Halsted has shown that the irrigation of fresh wounds by a solution of corrosive sublimate as weak as 1 to 10,000 is followed by a distinct line of superficial necrosis demonstrable under the microscope.

We are not so well informed as to the influence exerted by blood in a

wound. On the one hand, Von Bergmann and most modern surgeons lay the greatest stress upon prompt and careful hæmostasis in surgical operations; on the other hand, Schede has revived and more fully developed an old method of treatment, by which a certain class of wounds are permitted to fill with a blood-blot, and he and other surgeons have obtained rapid and aseptic healing by this method. Is this blood-clot, as such, a source of danger in the same sense as dead tissue is? As has already been mentioned, fresh blood-serum does not possess any such germicidal power over the pyogenic cocci as it does over the typhoid bacillus and many other bacteria. Not being able to find any direct experimental evidence upon the point, I have, with the assistance of Dr. Howard, made a large number of experiments upon dogs. The operations were done with strict antiseptic or aseptic precautions. In most of the experiments a cavity was chiselled out of bone, and this and the rest of the wound were allowed to fill with a coagulum of blood, the conditions pertaining to similar operations in human beings being observed. The blood-clot, after its formation, was inoculated with a culture of the staphylococcus aureus, either by injecting into it a few drops of a fresh bouillon culture or by inserting a platinum loop carrying a bit of the growth on agar. The outcome of the experiments was that the so-called organization of the blood-clot went on as it does in human beings, and the wounds did not suppurate. The staphylococci survived, at least for many days, in the clot, but they did not appear to multiply. This result is in conformity with the experience of Grawitz, who found that the aureus lives for a long time, although it does not multiply, in blood-coagula outside of the body, and that no development of this organism takes place in a solidified mixture of equal parts of nutrient gelatin and blood.

It is not my province to consider the extent of application of the method advocated by Schede to human surgery, nor the advantages of retaining the material employed by Nature in filling up cavities and pockets in fresh wounds as against the insertion of sterilized extraneous material and the obliteration of the dead spaces by deep stitches, which, without great care, are liable to strangulate tissue, produce undue tension, and interfere with the circulation.

Where the healing of the wound by the blood-clot method is not directly purposed, undoubtedly it is important for its aseptic course to check the oozing of blood and to prevent the unintended formation and retention of blood-coagula whose presence is not arranged for by the surgeon in the management of the wound. That loss of blood, as such, predisposes to suppuration has already been mentioned.

In contrast with the negative results of the experiments just mentioned stands a series of positive ones which illustrate the readiness and uniformity with which suppuration of an infected wound ensues which contains masses of tissue strangulated by ligature. These wounds were

inoculated with the same cultures which yielded negative results as regards the infection of the blood-clot.

We have made also a large number of experiments upon dogs by ligating portions of the omentum and then injecting cultures of the staphylococcus aureus, peritoneum. In most of these cases general peritonitis developed, in some localized peritonitis, and in some no peritonitis followed the inoculation.

In order to demonstrate the influence of foreign bodies in favoring suppuration, we inserted into the peritoneal cavity of nine dogs pieces of potato presenting a growth of the staphylococcus aureus, and in every instance general peritonitis developed, although in no case was the insertion of similar pieces of sterilized potato followed by peritonitis; and the injection of 1 c.c. bouillon culture of the staphylococcus aureus into the peritoneal cavity of twenty-three dogs was not followed in a single instance by peritonitis.

There is a gratifying harmony between the views entertained by bacteriologists concerning the power of the living tissues to overcome a certain number of pyogenic bacteria, and the tendency of the modern surgeon to respect these tissues more and more, not to destroy their vital capacities by the unnecessary application of strong chemical disinfectants, not to bruise them, not to make them too tense, not to strangle them, not to suffer the presence in wounds of spaces and foreign bodies, which remove bacteria from the influence of the living tissues and fluids.

From this necessarily hasty and imperfect survey of this division of our subject, it is apparent that, while there is no reason to doubt that the pyogenic cocci are specific agents of infection, the effects which they produce depend upon a variety of conditions, such as the source, the number, and the virulence of the micrococci, the accompanying toxic substances, the part of the body invaded, the readiness of absorption, the presence of foreign bodies and of pathological products, the general state of the patient, and the condition and handling of the wounded tissues.

In giving due weight to each of these factors one should not forget that the infectious material may exist under natural conditions, in a state capable of causing traumatic infections just as directly, just as certainly, just as independently of predisposition, as infection of a susceptible animal takes place with the anthrax bacillus.

As to the various ways by which pathogenic bacteria may gain access to wounds, there is at the present time general agreement of opinion that the greatest danger is from contact with infected hands, instruments, and other objects. The danger of infection by contact is a lesson which has been learned no less by bacteriological workers in the laboratory than by practical surgeons and obstetricians.

The possibility of infection from the air, insignificant as it may be in

comparison with contact infection, cannot be ignored quite as much as some seem inclined to do. The staphylococcus pyogenes aureus has been repeatedly found in the dust floating in the air, particularly of surgical wards where there are suppurating cases. The streptococcus erysipelatus was found by Von Eiselsberg in the air of a ward containing cases of erysipelas and the streptococci found by Prudden in the air of hospital wards were probably identical with this. When we had more confidence than we now have in the power of chemical disinfectants to destroy all bacteria which might accidentally get into a wound during a surgical operation, it seemed proper to disregard the air as a source of infection, and no less a surgeon than von Volkmann could say, "Auch auf einem Abtritte würde ich dreist operiren wenn die Hände rein wären." A privy, by the way, is not the most dangerous place which he could have selected.

Now that our trust in chemical disinfectants for the purpose named is shaken, and that what is called aseptic surgery is the watchword of the day, I believe that a surgeon who aims at the best will try to have the air of his operating-room as free from germs as possible, and will have it so constructed that the floor and walls and all that is in it can be readily cleaned and disinfected. He will regard the influence of currents of air and of commotion in the room in stirring up dust, and will not ignore the value of moisture in laying dust and in keeping it in its place. These suggestions may seem pedantic when the whole tendency of surgery now is to simplify technique and to throw overboard unnecessary ballast, but they appear to me to rest upon bacteriological facts which should not be ignored.

An example has already been given in this paper of auto-infection from the intestinal canal by the bacillus coli communis. The not infrequent invasion of the pyogenic cocci in typhoid fever, diphtheria, scarlet fever, and other diseases with lesions of the alimentary tract, are probably explicable partly by these lesions opening a passage for the bacteria into the circulation, and partly by the predisposition afforded by the presence in the body of toxic substances belonging to the primary disease. It is known that the pyogenic cocci are often present in the alimentary canal. For instance, in a case of perforative peritonitis from typhoid fever, recently examined in my laboratory, there were isolated from the peritoneal exudate, not in single but in many colonies on the roll cultures, the staphylococcus aureus and the streptococcus pyogenes, in addition to the typhoid bacillus, the colon bacillus, and an unidentified bacillus liquefying the gelatin.

Rinne observed in his experiments on dogs that the injection of sterilized putrid fluids together with staphylococci into the peritoneal cavity was followed by suppuration of all open wounds, which otherwise healed kindly, but that subcutaneous wounds were unaffected. The bacteria

found in the suppurating open wounds, however, were not those injected, but were derived from the air. This is unquestionably an interesting and important observation, but he goes too far in supposing that such wounds, as well as other loci minoris resistentiæ, may not become infected from pyogenic cocci in the circulation, as has been demonstrated by the experiments of De Wildt, Waterhouse, and others.

That even under the most unfavorable conditions of general infection a wound may heal by first intention is known to surgeons. In one of our cases, for example, the patient soon after an extensive operation for removal of a cancer of the breast, developed diphtheritic ulcerative dysentery; and at the post-mortem examination were found, in addition to the dysentery, pneumonia, abscess of the lung, and fresh pleurisy, with wide distribution of the staphylococcus aureus; nevertheless, the operation wound had remained perfectly healthy without a trace of suppuration.

Into the burning question of auto-infection from the genital tract in puerperal women I cannot enter, save to say that the pyogenic cocci seem to be present only very exceptionally in the normal tract and do not thrive there if intentionally put in, but that they are found in pathological utero-vaginal secretions, when, of course, they may become a source of puerperal infection. The question is a difficult one and requires further investigation. This passing mention is only intended to indicate that the subject belongs to our theme and may appropriately enter into the discussion.

I must beg permission to defer for a few moments the question of infection from the skin of the operator and of the patient.

That an aseptic wound is not necessarily one free from bacteria has been known since the early days of antiseptic surgery, the subject having been investigated by Ranke, Demarquay, Fischer, Schüller, Watson Cheyne, and others. Kümmell found that pieces of muscle, adipose tissue, or connective tissue taken from fresh wounds immediately after irrigation during the entire operation with corrosive sublimate solution 1 : 10,000, contained bacteria, and the same result was obtained after frequent washing with sublimate solution 1 : 1000.

The most recent investigation of the bacteria in fresh wounds treated antiseptically is by Bossowski, who found, of 50 cases, 10 with negative and 40 with positive result from the bacteriological examination. He found the staphylococcus albus 26 times, the staphylococcus aureus 9 times, the streptococcus pyogenes 2 times, and other organisms, non-pathogenic, 8 times. He several times found a coccus, liquefying gelatin after several days, growing at first white and then slowly turning yellow, and incapable of producing suppuration in rabbits or in wounds. This he proposes to call staphylococcus gilvus. In every case in which the staphylococcus aureus or the streptococcus pyogenes, with or without other organisms,

was present, suppuration occurred. On the other hand the staphylococcus albus produced generally no interference with the healing of the wound, but sometimes it caused a little suppuration of the drain canal or a stitch abscess. In the majority of cases there was absolute *prima intentio*. The small number of the colonies indicated meagre development in the wound.

Drs. Ghriskey and Robb have made under my observation the bacteriological examination of 45 laparotomy wounds treated with strict antiseptic precautions in the gynecological wards of the Johns Hopkins Hospital. The method of treatment and the technique adopted for obtaining the cultures have already been published by Dr. Robb, in the *Bulletin of the Johns Hopkins Hospital*, July, 1891.

Of these 45 cases the result was negative in 14, positive in 31, or nearly 69 per cent. of the cases. The organisms found were the staphylococcus albus 19 times, the staphylococcus aureus 5 times, the bacillus coli communis 6 times, the streptococcus pyogenes 3 times, once alone and twice in combination with the albus. Of the cases with the aureus in only two was there reason to suspect infection from without; in the others this organism was present in the seat of disease for which the operation was performed. In the first case with streptococcus pyogenes the operation was performed for an ovarian abscess which contained streptococci in large numbers; the other two cases probably became infected in some way from the first patient.

In all of the cases presenting the staphylococcus aureus or the streptococcus pyogenes the wound suppurated, and, as a rule, the general condition of the patient was bad.

In many of the cases where the white staphylococcus was found there was no disturbance in the healing of the wound. This was true especially when the organism was found in small number, and when it made its first appearance subsequent to the first dressing, which took place usually twenty-four to forty-eight hours after the operation. In many cases, however, the white coccus was the cause of more or less trouble, although rarely of a serious nature. It was found to travel down to the bottom of the wound along the side of the drainage-tube, and any purulent discharge attributable to its presence was usually confined to the tract occupied by the drainage-tube, so that the drainage-tube distinctly favored the invasion and growth of the coccus. Sometimes fever without suppuration seemed attributable to the presence of this coccus. That this organism is the most frequent cause of the ordinary stitch abscesses has already been mentioned.

Under especially favorable circumstances this white staphylococcus may cause peritonitis, as is shown by a fatal case of hystero-myomectomy where at the autopsy a volvulus of the ileum was found. The stump and the laparotomy wound both looked healthy, but there was a fresh

fibrino-purulent peritonitis clearly starting from that part of the peritoneum agglutinated to the inner edge of the laparotomy wound. This part corresponded to the peritoneum covering the twisted ileum. The twist was not so tight as to have produced gangrene or even a marked hemorrhagic condition; but it had interfered sufficiently with the circulation and the nutrition of the peritoneum to have rendered this a favorable soil for the growth of an otherwise comparatively innocent bacterium, our white staphylococcus having been found in pure culture in the inflamed peritoneum.

The efforts to find out the origin of this very common inhabitant of wounds, treated aseptically or antiseptically, have led us to some interesting and new observations concerning the bacteria of the skin.

The skin may have all sorts of bacteria upon its surface, but, like the mouth and the intestine, in addition to these it has its own distinctive bacterial flora.

If the hands be thoroughly scrubbed with soap and hot water with a sterilized brush, or if this be followed by washing the hands in sublimate solution and the mercury be precipitated by sulphide of ammonium, the cultures obtained from scrapings of the skin so treated will generally be found to contain, as the prevailing organism, the white staphylococcus, and often this will appear in nearly or quite pure culture.

But the most important point is that this coccus is very often present in parts of the epidermis deeper than can be reached by any known means of cutaneous disinfection save the application of heat. We were directed to this conclusion first by experiments on animals. Then the observation of the same white coccus in pure culture time after time in wounds where every possible antiseptic precaution had been taken, pointed to the same deduction. More conclusive evidence was afforded by the examination of skin stitches in cases where at the time of the operation it was proven that the silk used for stitches was sterile and that the surface of the skin after thorough disinfection was sterile. The silk sutures when removed were proven both by microscopical examination and by roll or plate cultures to contain with great regularity the white staphylococcus, often in considerable number, often enclosed within leucocytes, and this not only where a stitch abscess had formed but also where there was not a trace of suppuration or visible reaction around the stitch.

A crucial experiment is the following: The skin is thoroughly disinfected, in the manner to be presently described, so that culture-tubes of nutrient agar or gelatin inoculated by scrapings from its surface remain sterile. A silk thread, sterilized by steam and proven by culture methods to be sterile, is passed one or more times by means of a sterilized instrument through the skin, is withdrawn, and at once a tube of melted nutrient agar is inoculated with the thread and rolled. This amounts to a ready

means of making cultures directly from the deeper layers of the epidermis and the skin, and is a method applicable for many purposes to the bacteriological examination of the skin. By this method the presence of the white staphylococcus, often in pure culture, has been repeatedly demonstrated in parts of the epidermis deeper than were acted upon by any methods of disinfection of the surface of the skin. So far as our observations extend, and already they amount to a large number, this coccus may be regarded as a nearly, if not quite, constant inhabitant of the epidermis. It is now clear why I have proposed to call it the staphylococcus epidermidis albus. It possesses such feeble pyogenic capacity, as is shown by its behavior in wounds as well as by experiments on rabbits, that the designation staphylococcus pyogenes albus does not seem appropriate. Still, I am not inclined to insist too much upon this point, as very probably this coccus, which has hitherto been unquestionably identified by Bossowski and others with the ordinary staphylococcus pyogenes albus of Rosenbach, is an attenuated or modified form of the latter organism, although, as already mentioned, it presents some points of difference from the classical description of the white pyogenic coccus.

We can now understand how, without any flaw in the antiseptic technique of the surgeon, this microörganism may be present in wounds, and we have a satisfactory explanation of the frequent occurrence of stitch abscesses, although, of course, the inference should not be drawn that the white staphylococcus is the only bacterium which may be concerned in the production of these annoying complications.

How much practical importance attaches to the demonstration of this coccus in the deeper layers of the epidermis I am not prepared to say. The surgeon with good technique who does not bother himself about it is not likely to be severely punished by the behavior of his wounds. Those who put drainage-tubes and other extraneous substances into their wounds I think will have to consider it. Dr. Halsted, on the basis of researches on the bacteria of the skin and the difficulties of complete disinfection of the skin of the patient, has abandoned for nearly all wounds the use of skin stitches, the edges of the wound being brought together with admirable coaptation by subcutaneous sutures. The results, both as regards the scar and the aseptic healing of the wound, have been most gratifying. Stitch abscesses are, of course, avoided by this procedure.

Another coccus which we have found, although less frequently than the white coccus, on the surface and in the deeper layers of the epidermis, is one already referred to which corresponds to that called by Bossowski staphylococcus gilvus. This organism seems to bear about the same relation to the pyogenic yellow staphylococcus which our epidermal white coccus does to the typical pyogenic white staphylococcus.

The staphylococcus pyogenes aureus we have found very frequently

on the hands of surgeons and their assistants who have to do with suppurating cases of any kind. It may be present in this situation at least for several days after contact with surgical cases. It was met only exceptionally upon the hands of other persons.

The demonstration of microörganisms in layers of the epidermis deeper than can be disinfected by present methods suggests that more attention than seems now to be customary should be paid to the skin of the patient as a source of traumatic infections. It also admonishes us to receive with caution the statements recently made concerning the elimination in suppurative diseases of staphylococci by the sweat.

A considerable part of our work has been devoted to the subject of surgical antisepsis, and particularly to the disinfection of the skin. Dr. Abbott has conducted in my laboratory careful experiments regarding corrosive sublimate as a disinfectant against the staphylococcus pyogenes aureus, in which many fallacies in previous work on the same subject have been pointed out. In view of the time already consumed, I must ask permission simply to refer to Dr. Abbott's paper on this subject, already published in the *Bulletin of the Johns Hopkins Hospital* for April, 1891.

The conditions for the efficient action of chemical disinfectants have been found to be far more complicated and less easily controlled than was formerly supposed, and the substitution, wherever applicable, of the simple and certain methods of disinfection by heat, such as have been long employed in bacteriological laboratories, is to be commended. Chemical disinfectants still have their place for many purposes in the operating-room, but their place is not in fresh, healthy wounds.

Thorough scrubbing of the skin with soap and warm water by a sterilized brush removes many bacteria, but not all, and it cannot be regarded as a satisfactory means of cutaneous disinfection.

The fallacy in previous work on disinfection of the skin with corrosive sublimate has been that in testing its efficiency the sublimate was not first precipitated by sulphide of ammonium. If this precaution, to which attention was first directed by Geppert, be observed, it will be found that corrosive sublimate accomplishes much less than is generally supposed. Our revision of the work relating to cutaneous disinfection with sublimate has led to some curious and interesting observations, and to results which at first seemed paradoxical.

By examining the hands of surgeons who are in the habit of washing them daily in solutions of corrosive sublimate, it was found that the mercury becomes so intimately incorporated with the epidermis that its presence there can be demonstrated by means of sulphide of ammonium at least six weeks after any contact with mercurial solutions has taken place. Micrococci in the epidermis which have not been killed by washing in sublimate solutions, but which have been brought into such

relation to the sublimate that even after prolonged washing of the skin with alcohol and water they will not grow on culture media until the skin is washed with sulphide of ammonium, may also remain a long time in the epidermis. Hence it may happen that prolonged scrubbing of the hands of such persons simply with soap and warm water may remove so many superficial bacteria that the cultures from the scrapings of the epidermis may show very few, occasionally even no, colonies; whereas, when this is followed by washing in sublimate and then in sulphide of ammonium, a much larger number of colonies appear in the cultures. This apparently paradoxical result, which is obtained only from the hands of those who have previously washed them in sublimate solution, has no reference to the application of the sublimate immediately after the soap and water, but is to be explained by the liberation, by means of sulphide of ammonium, of the bacteria held in check by the mercury used, it may be, several days before the experiment. The same result is, of course, obtained if the sulphide of ammonium be applied immediately after the scrubbing with soap and water. These observations upon the persistence of mercury in the epidermis and its long-continued inhibition of the growth of bacteria, make it necessary in all work upon disinfection of the hands to first precipitate the mercury with sulphide of ammonium whenever the experiments are to be made upon hands which have been washed in sublimate solutions, even if this has occurred a long time previously. Exactly what relation the mercury in the epidermis holds to the bacteria which it does not destroy, but whose growth in our nutrient media it prevents, we cannot say. We may, perhaps, think of these bacteria as enveloped in an albuminous combination of mercury. One thing is certain—that, when the sublimate has been as thoroughly washed off from the skin as possible with water, or has been applied days before, the nutrient gelatin or agar is not rendered unfit for the growth of bacteria by the mere presence of the small quantity of mercury carried into it with scrapings from the epidermis, for the bacteria which have reached the epidermis after the application of the sublimate—and these are often identical with those inhibited by the mercury—develop as usual. It is only those bacteria which were originally brought into contact with the sublimate in some such manner as that suggested which will not grow until after the application of sulphide of ammonium, and it is not—as has been usually supposed in other observations of a similar kind in disinfectant experiments with sublimate—the alteration of the nutrient medium by the presence of a trace of sublimate which inhibits the growth of the colonies.

As to the practical efficiency of disinfection of the skin with solutions of corrosive sublimate, it is to be said that this agent, when properly applied, kills most of the bacteria upon the surface of the skin. The washing of the skin with alcohol immediately before the use of the sub-

limate increases its efficiency to a marked degree. If Fürbringer's method be carried out according to the strict letter of his directions it yields fair results, but it is not certain. If the mercury after employment of this method be precipitated by washing the hands in sulphide of ammonium, it will be found that the results are much less favorable than would appear by cultures made from the skin and under the nails, without the use of ammonium sulphide. It is especially the scrapings under the nails and around the matrix of the nails which yield positive results when ammonium sulphide is used, but often negative ones without this precaution. It need hardly be said that in our experiments all of the well-known, although often neglected, precautions to insure the full strength of the sublimate solutions were observed.

It may be urged that it is not necessary actually to kill the bacteria upon the skin; it is sufficient if they are rendered incapable of growth, and as most of those which are not killed by the sublimate do not grow upon our ordinary nutrient media, it is reasonable to infer that they will not grow in wounds. This line of argument certainly deserves consideration; nevertheless, there is no positive proof that these bacteria will not grow in wounds under some conditions, and surely one will feel safer with a method of disinfection which actually kills the bacteria.

I shall not detain you with the results of our experiments with other disinfectant agents. These will be published in a short time elsewhere. I shall simply state here that we have thus far obtained the best results in disinfection of the skin by the following method:

1. The nails are kept short and clean.

2. The hands are washed thoroughly for several minutes with soap and water, the water being as warm as can be comfortably borne, and being frequently changed. A brush, sterilized by steam, is used. The excess of soap is washed off with water.

3. The hands are immersed for one to two minutes in a warm saturated solution of permanganate of potash and are rubbed over thoroughly with a sterilized swab.

4. They are then placed in a warm saturated solution of oxalic acid, where they remain until complete decolorization of the permanganate occurs.

5. They are then washed off with sterilized salt solution or water.

6. They are immersed for two minutes in sublimate solution, 1 : 500.

The bacteriological examination of skin thus treated yields almost uniformly negative results, the material for the cultures being taken from underneath and around the nails. This is the procedure now employed in the gynecological and surgical wards of the hospital.

The principal conclusions of this paper may be summarized as follows:

The number of different species of bacteria, particularly of bacilli,

revealed by the systematic study of traumatic infections is much greater than was formerly supposed. The pyogenic staphylococci and streptococci, however, are by far the most common causes of suppurative affections of wounds.

A coccus, which may appropriately be called the staphylococcus epidermidis albus, is a nearly, if not quite, constant inhabitant of the epidermis, lying both superficially and also deeper than can be reached by present methods of disinfection of the skin. This coccus is found frequently in aseptic wounds. It may be the cause of disturbances, usually of a relatively slight degree, in the healing of the wound, especially when drainage-tubes are inserted. It is the most common cause of stitch abscesses in wounds treated antiseptically or aseptically.

The bacillus coli communis is a frequent invader of various organs of the body in cases with ulcerative or other lesions of the intestinal mucous membrane. In such cases its presence is usually unattended by evidence of pathogenic action, but this bacillus may be associated with inflammatory affections of wounds, with peritonitis, and with abscesses.

There are many reasons for believing that the process of suppuration serves a useful purpose in combating bacteria and preventing their invasion of the circulating fluids and the tissues of the body.

The pyogenic bacteria set up suppuration by means of chemical substances produced by them and entering into their composition. The studies of chemotaxis have shed much light upon the mode of action of these substances.

The effects produced in the animal body by the pyogenic cocci are determined by many factors relating to the infectious agents and to the individual exposed to infection. There are differences in these effects depending upon the species of animal, upon the tissues and part of the body infected, upon the readiness of absorption from the infected part; upon the source, the number, and the virulence of the organisms; upon the nature and amount of the toxic substances accompanying and produced by the bacteria, upon general predisposing conditions of the body, and upon local conditions in a wound such as the presence of foreign bodies, of pathological products, of dead spaces, of bruised, necrotic, and strangulated tissues.

Infectious agents, as they occur under natural conditions, may possess greater virulence than the same bacteria in artificial cultures, and this probably depends upon accompanying toxic substances.

Results of experiments on animals explain clinical experience concerning the aseptic healing of wounds by the so-called organization of a blood clot.

The tissues of a wound should be handled so as to interfere as little as possible with their vital capacity to overcome bacteria.

Although the greatest danger of infection of a wound from without

is by direct contact, nevertheless the possibility of infection from the air should not be disregarded.

Auto-infection may take place by the entrance into the circulation and tissues of pyogenic bacteria from the alimentary and the genital canals, but there is no evidence that this can occur when these tracts are in a healthy condition. Moreover, with the requisite lesions of these tracts other general and local conditions of the body are important, if not essential, factors in bringing about pyogenic or septic infection.

The presence in the circulating blood and tissues of certain chemical products of pyogenic and of putrefactive bacteria, as well as that of various other injurious substances, favors the growth in wounds of septic and pyogenic bacteria, both of those which may be carried to the part by the circulating fluids and those which may enter from outside of the body.

Whenever we have been able to demonstrate the presence in wounds in human beings of the staphylococcus pyogenes aureus or of the streptococcus pyogenes the wound either was suppurating or subsequently it suppurated.

Only in the minority of cases were the aseptic wounds which we examined free from bacteria. By far the most common organism in these wounds pursuing an aseptic course is the staphylococcus epidermidis albus, which without the presence of a drainage-tube or other foreign body rarely causes suppuration in the wound.

The presence of microörganisms in layers of the epidermis deeper than can be reached by existing methods of cutaneous disinfection points to the skin, especially to that of the patient, as a source of infection to be carefully guarded against.

The substitution so far as possible of subcutaneous for cutaneous sutures lessens the chances of infection from this source, and particularly those of stitch abscesses.

Wherever applicable in surgical antisepsis, disinfection by heat should be preferred to that by chemical agents.

Previous experiments to determine the efficacy of disinfection of the skin with corrosive sublimate are vitiated to a considerable extent by the failure to precipitate the mercury with ammonium sulphide before testing by culture methods its germicidal power on the skin.

The mercury remains for days and weeks intimately incorporated with the epidermis.

Epidermal bacteria not killed by the sublimate may be brought into such relation with it that they will not grow in ordinary culture media until the mercury is precipitated by ammonium sulphide, and such bacteria may remain for days and weeks in the epidermis.

The results of Fürbringer's method of disinfection of the skin are

found to be less favorable when they are tested after precipitation of the mercury with ammonium sulphide than without this precaution.

The best results in cutaneous disinfection we obtained by a method in which permanganate of potash followed by oxalic acid plays the principal disinfectant rôle.[1]

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[1] Cultures were exhibited showing various species of bacteria mentioned in the paper, the white staphylococci and other bacteria isolated from the epidermis, the growths from skin sutures, and illustrating the results of different methods of disinfection of the skin, and the importance of precipitation of the mercury with ammonium sulphide when testing the germicide action of corrosive sublimate on the skin.

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WOUND INFECTION: THE CAUSES WHICH PREDISPOSE TO ITS PRODUCTION, OR FAVOR IMMUNITY, AND THE ROLE OF ANTISEPTIC AGENTS.[1]

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The study of wound infection is inseparable from that of immunity from the same, and when we have learned that which constitutes or favors immunity, we shall approach nearer that which is now a *terra incognita.* As Brunton has well said, in his recent address before the British Medical Association, "immunity is a complex condition not dependent upon any single factor," and from pathological interest, as well as from clinical importance, our endeavor now must be to analyze the main question, of what constitutes or confers immunity, and try to first recognize and then solve its various subordinate queries.

This statement, too, is inseparable from another, which is to the effect that the surgery of to-day should aim to be *aseptic,* strictly speaking, and not merely *antiseptic;* in other words, we should abolish sepsis, and not merely aim to antidote it or conquer it when present.

The only excuse for surgery which is not strictly aseptic should be met with in cases of injuries where sepsis in some form has already occurred, or those where continuous aseptic precautions are impossible; as, for example, in the mouth, rectum, etc., or in military practice, where the exigencies of the occasion do not permit that which we would ordinarily carry out with precision.

The condition of sepsis itself is a most complicated one, consisting, as far as we now see, of a condition of poisoning by ptomaines, toxines, and albumoses having widely varying strength and properties, some of which are so antagonistic in physiological action to others, that one may

[1] An address delivered before the Second Triennial Congress of American Physicians and Surgeons, at Washington, D. C., September 22, 1891.

neutralize another, as it is well known often occurs. Some of these substances are perfectly harmless in their proper places, but deadly in others. The chemical processes going on within our bodies are as complex and as difficult of appreciation as are those mental processes which so bewilder us when sometimes we endeavor to study and read the character of various individuals. Virchow, in his address before the Tenth International Congress, voiced the general sentiment when he said: "The scientific problems of medicine are, for the most part, centred about the determination of the biological peculiarities of animal and vegetable cells." (*Vide* paper by Braatz, *Deutsche med. Wochenschrift*, 1891, No. 22.) "Lépine has lately shown that while the pancreas is pouring into the digestive channel the ferment which will form sugar, it is at the same time emptying into the system another ferment which will destroy it." (Brunton.)

But this is no more than is constantly happening in the alimentary canal, into which the intestinal glands are constantly pouring fluids which shall assist in the digestion of ingesta, while the intestinal absorbents may be taking up poisons produced by their mutual reactions. I esteem the proper realization of this fact as of great importance to the surgeon, as well as a due recognition of the organ through which these various poisonous substances are filtered out before reaching the systemic circulation. The physiologists have shown us that the organ by which this is accomplished is the liver, by virtue of its so-called depurative action. This is but one of its multiple functions. I have upon another occasion endeavored to show that it is by virtue of this hepatic function that many cases of septic intoxication in surgical patients are avoided, and that when this function is interfered with, the most promising surgical case may go wrong or even terminate fatally.[1] I have also there endeavored to show that in the division of the general subject of blood-poisoning a condition which we will call, if you please, intestinal toxæmia, or entero-sepsis, deserves a distinct place; that it occurs not infrequently; that by a continuation of it the condition may be merged into one of sapræmia, septicæmia, or pyæmia, and that when promptly antidoted or checked there is a speedy return to a desirable condition, both of wound and of the patient.

All of which leads to a statement upon which I desire to lay all the stress it may bear, which is to this effect—that when we have apparently commencing sepsis we are altogether too prone to look first to the wound itself for an explanation of its origin. I claim—basing this claim upon observation and laboratory study—that by no means all cases of surgical sepsis have their origin in or about the wound, no matter

[1] "Mütter Lectures on Surgical Pathology." Annals of Surgery, vol. xiii., June, 1891, p. 446.

how soon the wound may begin to show changes. To this statement I shall recur after a little.

As bearing on what has already been said, however, I wish to appeal to the personal experience of all those who have done general or special surgery. The very facts that careful surgeons prepare their patients for operation and that those who institute the most careful measures in this direction enjoy the greatest success, are, of themselves, proofs of the strength of this position. And the practice which has obtained from time immemorial in such septic conditions as puerperal fever, and many others, of giving a purgative, by which the alimentary canal is freed of toxic materials and the action of the liver stimulated, is additional evidence in the same direction. However others may interpret these conditions, the individuality of a condition of entero-sepsis is for me too apparent to be contested.

We have learned a little, and have yet much to learn, with reference to the antagonisms of different bacteria and the poisons which they produce. If a microbe can enter the system and produce a proteid or albuminoid poisonous to the animal harboring it, it may there thrive and produce such poison, while the injection or the introduction of some other substance may neutralize this poison and save the animal. The principle involved herein is the same whether the antidotal poison be injected as such, or whether a second species be inoculated by which it may be produced. The study of proteid materials is even yet so occult that we know but little about them. Were the truth concerning all the details of our body chemistry known, we should see in every human being a laboratory in which are going on more processes of manufacture and destruction than can be witnessed even in a World's Fair.

Brunton has suggested that blisters do good in this way, not merely by affecting the circulation, but by an endermic administration of proteids derived, of course, from the blood, but so altered in passage from the vessels as to have a different effect, and probably also, as will be seen, by their chemotactic properties. He also suggests that bleeding may be of benefit in a similar way, since experiments have shown that by abstraction of venous blood there is caused absorption of proteid matters from the tissues, and that these proteids may have an action of their own on tissues with which they may come in contact. The indisputable benefits, in many cases, of free purgation probably finds here also its proper explanation.

I have already introduced a term implying a condition but recently recognized, to which it seems necessary to ask your attention for a few moments. It is known under the name, given it by Pfeffer, of *chemotaxis*, and refers to that faculty possessed by all motile bacteria of moving toward or away from certain substances which seem to attract or repel them. This faculty is, however, by no means confined to the bacteria,

since Stahl has shown that the same power is inherent in the plasmodia of myxo-mycetes, as well as in various other unicellular organisms; and what especially concerns us here is the fact that the leucocytes at least, if not various other cells of our own bodies, possess the same property. As yet a general recognition of this fact hardly obtains among the profession, although an elaborate article on the subject has been published recently by Prudden;[1] but it seems to me a matter of common importance to all who study inflammation and its results. Observers in this direction have shown that bacteria, for instance, move toward nutritive material, and this power has been utilized by Ali Cohen to separate motile from immotile bacteria. He filled capillary tubes with positive chemotactic material, like potato-juice, and with this could attract typhoid and cholera bacteria from fæces, and thus make their pure cultivation much easier.

The chemotactic properties of leucocytes remind one very much of the so-called tactile sensibilities which the amœbæ possess, only they enjoy them in perhaps higher degree. Lactic acid, 10 per cent. salt solution, quinine 0.5 per cent., 10 per cent. alcohol, chloroform, glycerin, and bile produce in leucocytes chemotactic activity by which they are repelled. It must be said here that chemotaxis is spoken of as positive or negative, according as there appears to be attraction or repulsion. Among the most actively positive chemotactic substances are cultures of bacteria. These are powerfully attracted by the leucocytes. Hence it appears that bacteria and leucocytes are mutually attractive, and the effect is the same whether the cultures are alive or have been killed by boiling; but it is not the culture medium itself by which this activity is manifested, but by some product of the life and growth of the bacteria.

It has been Buchner's happy lot to widely extend our knowledge of the function and importance of the leucocyte in its chemotactic relations. He has demonstrated that its phagocytic action is but a part of that general power which it possesses of responding to chemotactic attraction and incorporating into itself whatever there is of foreign, dead, or offending material, and then removing it. It matters not that it often perishes in this attempt, that is, it matters not in a logical sense, although a quantity of leucocytes which have thus perished constitute a mass of pus, their dead bodies remaining in this form to show the violence of the conflict, and, as it were, their heroism in the engagement. In other words, it follows from Buchner's researches that the process of resolution is in large measure, or for so much as concerns the solid material resorbed, a matter of chemotactic attraction and its results. Furthermore, that of all substances, that which seems to offer the most attraction for leucocytes is the albuminoid material furnished by bacterial cells

[1] New York Med. Journ., June 6, 1891, p. 637.

It is this that attracts leucocytes, which are brought to the infected area by a magnetism, so to speak, which they cannot resist. This statement is especially true of proteid or albuminoid materials without reference to alkaloids, etc., produced as special products of individual forms. This is the explanation of those cases of that anomalous and clinically unimportant condition known as non-bacterial suppuration, sometimes produced in the laboratory. It is evidenced in such results as those of Wyssokowitsch, who filtered the fluid off from anthrax cultures and found that the filtrate was not pyogenic, while the solid material was.

By ingenious use of Councilman's tubes Buchner proved for the pneumo-bacillus of Friedländer that its free albuminoid material has a marked pyogenic action, and so with numerous others, especially the staphylococci, the bacillus pyocyaneus, and the typhoid bacillus.

It appears thus that the chemotactic activity of bacteria may be exerted by them whether living or dead. In either case they seem to attract toward them leucocytes which then and thus act as scavengers for the surrounding tissues. Buchner has further shown how vegetable caseins and alkali-albumins possess the same chemotactic possibilities.

I would not detain you with a rehearsal of these facts, interesting and important as they are, were it not that they appear to have a most important bearing upon questions which vitally concern the surgeon. First of all, I do not see how in the light of such researches the possibility of phagocytosis can be denied, and the importance of this process looms up in a flood of light when one discusses the phenomena of suppuration, or of other kinds of infection as well as of recovery or immunity therefrom. In suppuration and in absorption, it is proteid material which attracts the leucocytes, the same being furnished either by bacteria or by disintegrating tissue suffering from other infection. Metschnikoff, assuming the truth of his own theory of phagocytosis, invokes that of chemotaxis to explain immunity and freedom after one attack of a contagious disease. He claims that the variety of chemotaxis is variable, and that positive may be converted into negative, or *vice versa*, and that cells may be attracted to substances in mild form, which in strong form they repel, so that by inoculating with attenuated virus chemotaxis at first negative will change slowly to positive, and the phagocyte will at last be induced to attract and attack the invading element of disease. Whatever may be the final outcome of this perhaps fanciful development of his original theory, it is at least the result of laborious research and patient watching.

Those interested in the phagocyte explanation of conferred immunity will find choice reading in the *Transactions* of the recent International Congress of Hygiene and Demography, where, for instance, Roux, Buchner, Kitasato, and Metschnikoff himself, expounded the views which have set students the world over to thinking and to renewed investiga-

tion, and which have made their originators famous. Let it be enough for our present purpose to say that the theory of phagocytosis appears to be more strongly grounded than ever, and that were we deprived of the theory, though acquainted with the facts which corroborate it, we should be at great loss for any rational explanation of the same.

Support of the phagocyte theory has also come from another source, namely, from Hankin's recent work on *Defensive Proteids.* From the spleens and livers of various animals he has isolated the proteid which has the power of killing bacteria, and he has found that this, though absent from normal blood, could be obtained from that of febrile animals. There follow from these facts, if true, various deductions as to the impolitic course of too strenuous efforts to reduce fever in septic cases, upon which, if there were time, one might wish to dwell. This also agrees with Hankin's suggestion that phagocytes not only kill microbes which they have taken in, but can also, by liberating their contents, exert a bactericidal action. It also makes plausible the view that animals that are refractory to particular diseases have the power of producing some particular variety of defensive proteid. There is here opened a most attractive though difficult field for study.

The next important bearing of these views is with reference to the absorption and separation of dead or dying materials, such as large sloughs after extensive burns. These, of course, are loosened by physiological processes in which the formation of proteid material figures largely. By the positive chemotactic properties already alluded to, this attracts leucocytes in large quantities and brings them in numbers where they are needed for tissue repair, and at the same time explains, perhaps, the poisoning with which in these cases we have to deal.

A third not less important bearing is on the use of so-called antiseptic agents. The ideal antiseptic is probably blood serum; its parasiticide properties being, in all probability, connected with the existence in it of a globulin which is only soluble in a weak solution of common salt. This, by the way, may explain the well-known antiseptic action of common salt, and, as Spencer Wells has said, may strengthen the belief that we have in dilute saline solutions a safe and useful fluid for surgical irrigation, preferable to water which has been sterilized simply by boiling, and to various other solutions which may irritate the tissues.

I am not aware that as yet any systematic study of the various antiseptic materials now in general use by surgeons, with reference to their chemotactic activities, has been made. It strikes me, however, that such a study offers the greatest promise of aid in the decision as to what antiseptic to use. But it will be easily seen that once having appreciated this peculiar attraction or repulsion between organized or unorganized materials, we shall have reason to hesitate and reflect before we apply to fresh, raw surfaces, which are supposed to be free from infec-

tion, materials, *i. e.*, antiseptic agents, of a character which may disturb the ordinary physiological course of events by begetting such inordinate excitement, serous outpour, and gathering of the leucocytes, as we have seen may occur.

Although it be here a digression, I cannot avoid for a moment stopping to epitomize some of Hankin's recent work, as well as that of Behring and Kitasato, concerning blood serum and its properties.

The work of Buchner and Nissen showed that the bactericidal action of pure blood serum is an important factor in the conflict between the microbe and the animal organism. This has been further confirmed by Bouchard, who showed that the serum of a rabbit will serve as a culture medium for the bacillus pyocyaneus; but if a rabbit be made immune against the diseases caused by this bacillus, the bacillus can no longer be cultivated on the serum of that particular animal. In other words, by making an animal immune against a disease the bactericidal action of its serum is greatly increased. This is true also in the case of cholera, anthrax, hog-cholera, and other diseases. The investigations of Behring and Kitasato have yielded astonishing results. They found that the serum of a rabbit which had been made immune to diphtheria or to tetanus exerts no bactericidal action on the bacilli of these diseases; but that it does possess the remarkable power of destroying the poisons produced by these microbes. In other words, that such serum has *antitoxic* and *not bactericidal* power, and by taking advantage of such power Behring has cured mice of tetanus in which the disease had so far progressed that two or three limbs were in a condition of spasm. Hankin, in a very recent address (*Lancet*, August 15, 1891, p. 339), in discussing this topic, gives the following definition of immunity in the light of recent study: "Immunity, whether natural or acquired, is due to the presence of substances which are formed by the metabolism of the animal rather than by that of the microbe, and which have the power of destroying either the microbe against which immunity is possible, or the products on which their pathogenetic action depends." In giving this definition he expressly states that it is not comprehensive for all instances, and that in some animals immunity against certain diseases depends wholly or in part upon their causes.

He then goes on to briefly describe how he was able to separate from serum the particular compound which conferred this power. He finally narrowed it down to and isolated a particular ferment-like proteid, known as cell-globulin B. And he further showed how this and other defensive proteids in animals, and we may conclude also in man, can be altered in amount by various conditions of diet, environment, etc.

For these defensive proteids Buchner has suggested the name *alexine;* but Hankin would discriminate between them more carefully, and has divided them into those which occur naturally in normal animals, which

he proposes to call *sozins*, and those occurring in animals that have been articially made immune—these he would term *phylaxins*. The former he has found in all animals yet examined. He further shows how each of these classes can be subdivided into those that act on bacteria and those that act on the poisons they generate. These sub-classes he would denote by the prefixes *myco-* and *toxo-*; thus *mycosozins* are proteids of the normal animal which have the power of destroying various bacteria, and *toxosozins* are proteids occurring also in the normal animal, which destroy or antagonize the poisons of bacterial origin. Similarly *myco-phylaxins* and *toxophylaxins* will denote the classes of the phylaxins.

It has already been stated that by no means all the sources of sepsis concern the wound itself. It is necessary now to classify and briefly allude to the principal reasons why a wound, or a patient who suffers from it, may not be able to resist infection from other sources; or, in other words, to mention the principal other sources of infection possible. These I would classify as follows:

1. Previous long-existent toxæmia (*e. g.*, syphilis, diabetes, acetonæmia, lithæmia, alcoholism, malaria).
2. Previous anatomical changes which reduce vitality (*e. g.*, inherited diatheses, old age, amyloid change, chronic and acute nephritis).
3. Recent or acute toxæmia (uræmia, typhoid, intestinal toxæmia, stercoral toxæmia).
4. Other acute conditions (starvation, scurvy, anæmia).
5. Conditions of environment (bad hygienic surroundings).
6. Effect of anæsthetics.
7. Effect of antiseptics.

1. *Previous long-existent toxæmia.* The disastrous results of operating upon diabetic patients, as well as those presenting active manifestations of syphilis, have long been recognized by surgeons. Nor does one deliberately operate on patients suffering from chronic alcoholism or malaria, if he can avoid it. Other conditions which deserve to be mentioned here as having an occasional yet distinct bearing in this direction are lithæmia, cholæmia, acetonæmia, and the various conditions which are represented by the presence of the oxalates, uric acid, acetone and peptone in the urine.

2. *Previous anatomical changes which lower vitality.* Old age, with its accompanying arterial sclerosis, its cardiac debility, and other well-known tissue alterations, favors sluggishness of wound repair, leads not infrequently to sloughing or to bedsore, and predisposes toward sepsis. Amyloid changes betoken impaired vitality, and chronic or acute nephritis implies that excretion may be interfered with, and some form of toxæmia thereby induced. The inherited diatheses, including tuberculosis and syphilis, may or may not be factors of considerable importance in this respect.

3. *Recent toxæmia.* To illustrate this class of cases a little better, let me mention an illustrative case: A middle-aged woman, of healthy antecedents, recently convalescent from typhoid, which had run an average course, presented a rapidly growing tumor (sarcoma) in one breast. So rapid was its growth that operation could not be delayed. It was made with every aseptic precaution. Nevertheless the skin flaps, which would ordinarily have united without pus, necrosed completely, and left a large surface to heal by granulation.

No one would wittingly operate on a patient suffering from uræmia save in dire emergency. To the condition of entero-sepsis, intestinal toxæmia, or fæcal or stercoral intoxication, I have already alluded. My own studies and experience with this condition have led me to profound conviction, since time and again I have seen commencing septic wound disturbance aborted by the institution of measures calculated to clear out the alimentary canal, this being true of wounds in all parts of the body. The same is true, also, of the toxæmia produced in puerperal, diphtheritic and scarlatinal cases, in which, as is well known, we operate only when compelled to in the interest of life.

One form of entero-sepsis upon which but little has been written, and yet which furnishes a clue to many fatal cases, especially those connected with abdominal surgery, is that produced by the bacillus coli commune. This, as is well known, is a regular inhabitant of the alimentary canal, and its presence there is presumably connected with the chemistry of digestion. Yet, under certain circumstances, it either escapes or is carried beyond its normal limits, and, entering the portal circulation, perhaps the lymphatics also, appears to set up septic disturbances which are typified by the production of septic peritonitis, and possibly other forms of septicæmia in which the peritoneum does not primarily figure. The subject is an inviting one for further research; the condition has hardly yet been dignified by a proper and distinctive name, though Drs. Welch and Councilman, who should be credited with its discovery, term it "colon infection." It is mentioned here only as one variety of entero-sepsis, and as one in which, perhaps, good results are obtained in such cases as those which the gynecologists often meet with, namely, of incipient septic peritonitis, in which the administration of a large dose of magnesium sulphate appears to provoke not merely catharsis, but absorption of septic fluid from within the peritoneal cavity.

4. *Other acute conditions.* As representatives of this group should be mentioned starvation, scurvy, acute anæmia such as follows the post-febrile and post-puerperal state. By all of these conditions vital resistance is so lowered that infection from within or without is greatly favored.[1]

[1] Concerning the influence of hunger upon immunity and infection, vide Canalis u. Morpurgo, Fortschritte der Medicin, viii. pp. 693, 729.

5. *Conditions of environment.* Emergency is the only justifiable reason for surgical operation where the hygienic surroundings are bad. Universal experience justifies this statement, but experimental proof of the same is not lacking. The experiments of Trudeau beautifully exemplify this. He inoculated a number of rabbits with tuberculosis, isolated them upon a small island in the Adirondack region, fed them well, gave them every benefit of fresh air and sunlight, and, upon killing them four months later, only one was found to present the slightest evidence of tubercular disease. The same number of rabbits in another group were inoculated in the same way and confined in a dark cellar, amidst damp air with poor ventilation. These became rapidly diseased, and without exception all were notably tubercular. (THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, vol. xciv., July, 1887, p. 119.)

The popularity of fresh-air missions, the benefit of removal of the poor and ill-fed to good hospitals for operation, and numerous other well-known facts, attest the importance of the matter of environment.

6. *Effect of anæsthetics.* There is good reason to think that chloroform and ether administered for some time may produce such changes in the blood and tissues that vital processes of repair, cell resistance, and chemotaxis may be so far interfered with as to facilitate subsequent infection. In making this statement I feel assured of the corroboration of surgeons generally. Yet I know of no particular researches bearing upon it, and would suggest it as offering a fine field for orginal research.

7. *Effect of antiseptics.* Upon first blush the idea that an antiseptic may favor infection would seem to be essentially opposed to facts. Yet the fact is made clear, both by clinical experience and by experiment. Such an event may happen in more than one way. Mercurial and iodoform poisoning are by no means unknown to the surgeon as arising from the use of these drugs for antiseptic purposes. When this condition is established the case becomes at once one of recent toxæmia, to which I have already alluded. That wounds will fail to unite, and that suppuration will occur in these toxæmic conditions, is well known. The individual is so poisoned that his cell-resistance is diminished or destroyed, and in consequence there is little or no opposition to infection.

The other method is by such chemical reaction between vital fluid and antiseptic agent that decomposition of one or both ensues, the antiseptic itself being decomposed, its properties as such lost, while the tissues upon which it acts may have their constitution so changed as to favor rather than resist infection. The best experimental proof of this statement that I know of has been furnished by Abbott (*Johns Hopkins Hospital Bulletin*, April, 1891). Without rehearsing his experiments with mercuric chloride, let me simply remind you of his conclusions:

1. That under the most favorable conditions a given amount of sublimate has the property of rendering inert only a certain number of

individual organisms, since there is a definite chemical reaction between the bacterial protoplasm and the mercuric salt.

2. That the disinfecting activity of sublimate against organisms is profoundly influenced by the proportion of albuminous material contained in the medium in which the bacteria are present.

3. That the relation between staphylococci and sublimate is not a constant one, since organisms from different sources and of different ages behave differently when exposed to the same amount of the salt for the same length of time.

4. That the organisms which survive exposure may experience a temporary attenuation, which, however, may disappear by successive cultivation. (His other conclusions enumerated are irrelevant here.)

From these studies he justifies the statement which has been frequently made, that to the employment of sublimate solutions upon wound surfaces it is plain that there exist at least two serious objections:

First, that the albumin of the tissues and fluids of the body tends to diminish the strength of, or render entirely inert, the solution employed. Since the surgeon possesses no means by which he can determine the amount of such material with which his solutions are to come in contact, he is therefore never in position to say *à priori* that his efforts at disinfection of a wound are or are not successful.

The second objection is that the integrity of tissues is materially disturbed by the application of solutions of this sort.

There is abundance of evidence to lead to the belief that normal tissues and fluids of the body possess the power of rendering inert many kinds of organisms which may have gained access to them. This function must therefore be diminished or destroyed by agents which bring about alterations in the constitution of these tissues. Such changes are known to follow the application of sublimate solutions, which may cause a condition of superficial necrosis, by which the inroads of infectious organisms are not resisted as they would have been had the tissues been left in their natural condition.

From all of which it would appear best to keep not only those, but all other antiseptic agents away, from absolutely clean flesh surfaces. The experiments of Nuttall, Lubarsch, Von Fodor, Bonome, Springfeld, and others have shown the value of blood serum as an antiseptic, while the experience of all laboratory workers points in the same direction. Such serum will always be poured out, it is presumable, in quantity sufficient to serve not only as a cohesive but as an antiseptic agent.

Just here in passing the query is provoked, What agent can best be used as an antiseptic? We are learning every day that, providing everything else be clean and fresh, wounds such as made by the surgeon will also be clean, and that the dry method of operating is, per-

haps, the best of all; but inasmuch as the surgeon is often compelled to disinfect an area which has already become infected, he must perforce employ some actively antiseptic agent. It would appear that for most purposes we find the ideal in peroxide of hydrogen, which not merely destroys living organisms, but by oxidation of all undesirable and infected material acts as a scavenger of the tissues, and, in one phrase, when it can be efficiently employed locally, is the conqueror of sepsis.

While such artificial agents as the peroxide must rank as among the highest of their class, it seems to me that we have yet to learn how to utilize to fullest advantage the properties of blood serum. To be sure, this varies among the different animals, and by the limitations of experimental study we are less familiar with such as are possessed by the serum of the human blood than with those enjoyed by that of various animals. For instance, it is well known that a mouse will die of inoculated anthrax, while a rat will not. Also that if the inoculated mouse receive a few drops of rat blood serum it recovers. Practical advantage has been taken of this principle, and it has been proposed, and even carried out, to inject into consumptive patients blood serum of the goat or dog, which are known to be almost immune from tuberculosis. Bonome has found that staphylococci thrown directly into the blood of young animals are there destroyed much more quickly than in that of old animals, namely, in from ten to twenty-five minutes. (This has a bearing on the effect of old age already alluded to.) This bactericidal action of the blood is enhanced if the poisonous extract of empyemic or rather of any old pus be injected into the animal before the experiment, while the extract of recent or acute pus has no such effect. On the other hand the latter, *i. e.*, the extract from acute pus, appears to diminish the chemotactic or phagocytic power of the cell elements. Water also diminishes this bactericidal power of the blood, and an important inference may be drawn from this with reference to the advisability of infusion of saline or other solutions for the relief of acute traumatic anæmia.

Having discussed immunity and conditions which predispose to infection, let us consider how direct infection may be brought about. Infection may be divided into two varieties: Self- or auto-infection and contact infection, including that from the skin and wound, from the air, and from ingesta. And yet, while making these two varieties, namely, infection from without and from within, it must be stated that infection as such is presumably due to the same organisms in either case, and that such varieties are arbitrary and not founded upon essential differences. The causes which lead to auto-infection have been already alluded to, as well as those cases of contact infection which originate from the air and from improper food. To be sure, the experi-

ments of Kocher, and of others, in the direction of feeding animals with putrid or putrifying material, and then insulting the thyroid or bone-marrow, in the endeavor to provoke acute sepsis by infection from the alimentary canal, have not been sufficient to completely satisfy one that by improper food alone sepsis may be caused. But I would make a sharp distinction between such experiments and their results, and the condition of entero-sepsis, which includes only a condition of toxæmia arising from presumably proper food, undergoing perverted chemical changes within the alimentary canal, and there producing poisons as the result of such changes, which, when absorbed, give rise to deleterious effects.

But contact infection, as it usually occurs, arises from the air or from some other unclean foreign substance which comes in contact with exposed raw surfaces. Air contact, is, on first thought, a most fertile source of trouble. Pasteur and Lister first made us fear the air as the most dangerous medium of all, but we have gradually learned that its dangers in any proper operation locality are so small as scarcely to deserve consideration in comparison with the others to be mentioned. Not that germs may not be deposited from the air just as they are in an improperly protected culture-tube, but that nearly all of these are non-pathogenic, and that they, with the pathogenic forms, are nearly always either washed or wiped away, or are destroyed by the blood serum or the phagocytic action of the cells.

The principal sources of contact infection are to be enumerated as follows:

1. Skin and hair.
2. Instruments.
3. Sponges or their substitutes.
4. Suture materials.
5. The hands of the surgeon and his assistants.
6. Drainage materials.
7. Dressing materials.
8. Miscellaneous, *e. g.*, drops of perspiration, an unclean irrigator-nozzle, the nail-brush, the clothing of the operator or the bystanders, etc.

1. *Skin and hair.* The danger here comes not so much from what may be on the surface as from that which may be contained within the hair-follicles and sebaceous and sudoriparous glands. The prevention of infection from this source, therefore, requires more than ordinary shaving of the surface or superficial application of soap and water. Lister claimed for carbolic solutions that they had the power of impregnating greasy material with their antiseptic virtues, though as the latter are very questionable we must doubt the former. But it is vitally necessary that, by whatever means we may, we should make our pre-

cautions reach into these crypts, for the possibility of the hibernation of infectious organisms in the crypts or even the tissues of the skin has been experimentally proven. This is especially true of the streptococci of erysipelas, which have been found latent, but alive, within the skin long after the subsidence of active manifestations of the disease, the skin having become apparently, at least temporarily, tolerant.

What then are the best means of sterilizing the skin? These must depend upon whether time is afforded for careful preparation or not. When we deliberately do a craniotomy or laparotomy we have ample time for such measures, but when an amputation for injury, time and means are both limited.

In the former instance, there should first of all be a careful shaving of the skin, the razor being, as some Frenchman has described it, an admirable dermal curette. I would prefer, then, to use for a day or two some antiseptic ointment, properly prepared (see No. 8), such as one made with resorcin or lysol, and lanolin, by whose use we may hope to bring about absorption into the skin of the antiseptic employed. After one or two days' use of this, the skin should be again thoroughly washed, and for this purpose the best soap is the sapo viride of the German Pharmacopœia, with 5 per cent. of lysol or hydro-naphthol. Now for an equal period there should be worn over the part a compress kept moist with some liquid, non-irritating antiseptic. For this purpose creolin or lysol, 5 per cent., or hydro-naphthol in saturated cold aqueous solution, perhaps with a little glycerin added, should be worn until the time of operation. Now everything being ready and the patient being anæsthetized, a final scrubbing with hydro-naphthol soap with shaving should be practised, and then the skin washed with equal parts of alcohol and ether or alcohol and turpentine. By this means the operator may feel confident that the surface has been thoroughly disinfected.

In cases of the other class, where time for this programme is not afforded, we must content ourselves with the thorough use of the nail-brush, the razor, and antiseptic soap, with the subsequent use of alcohol and ether upon the skin.

2. *Instruments.* Aside from the information which has long been at hand with regard to the necessity of having clean instruments, I know of nothing so significant as the experience of Thiriar, who had several cases of tetanus following his operations, and whose disastrous experience ceased as soon as he sterilized his instruments by heat. That instruments should be in some way sterilized is now everywhere accepted. The question is now solely with regard to the best method, whether with dry heat, in steam, or by boiling. It appears that the method of dry sterilization injures the instruments, especially those with keen edges, less than any other. For my own part, I prefer a dry sterilizer in which they are subjected for half an hour to a temperature of 140° or 150° C.,

although I prefer to content myself with passing a delicate cutting instrument two or three times through the flame. Long immersion in hot water certainly does injure all edged instruments, as does also superheated steam or hot air.

3. *Sponges.* There appears to be nothing to add in this connection to the well-known directions for cleaning and sterilizing sponges. It is important, however, to know whether a sponge which has once been used can be employed again. A careful series of experiments has convinced me, at all events, that sponges which have been used in non-septic cases, and have been carefully cleansed and immersed in antiseptic solutions for a week or more, contain no bacteria that can reveal themselves after approved culture methods.

Nevertheless, in order to be absolutely on the safe side, it would appear better, in many respects, to use some cheap absorbent material as a substitute for sponges, which can be used once and thrown away. There are numerous materials which we can thus employ, proper care being given only to see that they are both absorbent and sterile. A final cooking or baking shortly before use will insure at least this latter point.

4. *Suture materials.* These are mainly animal or metal; silk, catgut, horsehair, and silkworm-gut being the best examples of the former, and iron, copper, silver wire, of the latter. Two essentials are requisite in all material for suture, namely, strength and sterility. Power of resorption is a secondary consideration, although very necessary in certain cases. We may at once dismiss metal sutures from consideration, since it is the simplest possible measure to sterilize them. But the proper sterilization of animal suture or ligature material is a problem on which a great deal of time has been spent. (See the researches of Brunner and of others.[1])

Silk may be sterilized by boiling, but this weakens it. The best method is to wind it upon glass spools, to drop these into a large test-tube, to plug the tube, and then keep it for an hour in a steam sterilizer, upon two different occasions. Silkworm-gut appears to be much less septic naturally than is catgut, and may be sterilized by immersion in 1 per cent. aqueous sublimate solution for a few hours, and then preservation in alcohol.

But it is with regard to catgut that the greatest study has been excited, and the largest number of preparation methods suggested. It is not necessary here to detain you even with allusion to the work which has been done in this direction, interesting as it may be. Permit me to simply briefly state what I consider the safest and best method by which

[1] Beiträge zur klinischen Chirurgie, vi. 98; Braatz, Ibid., vii. 70; Klemm, Archiv. f. klin. Chir., xli. 4.

to insure the sterilization of catgut. The raw gut, preferably that which has been prepared in the factories for surgeons' use, should have, first of all, its fatty material dissolved out by immersion in benzene or ether. It is then allowed to dry and is soaked for one or two days in a 1 per cent. watery solution of corrosive sublimate, after which it is dried and transferred to oil of juniper berries, and from this to strong alcohol containing one per mille of sublimate. (In this, if desired, it can be boiled.) Catgut thus prepared will, so far as we know, resist every attempt to cultivate bacteria from it. If it be desirable to chromicize it, this may be done before it is placed in juniper oil.

I have, like many others, tried various experiments to accomplish the same results by other means, including moist and dry heat, etc., yet know of nothing which gives such universally satisfactory results as the above.

5. *The hands.* The hands of all those concerned about the field of operation should be carefully disinfected. This includes the surgeon, his assistants, and the nurses or attendants who may handle sponges or dressings. It has not required such laboratory studies as those of Kümmell and others to show that ordinary methods of cleansing the hands do not bring about an aseptic condition. The thousands of times that wound infection has followed contact with the unclean hands of the surgeon or obstetrician bear witness to this fact. It is simply a truism to state that cemeteries have been filled in time past by the septic hands of medical attendants.

How then disinfect them? It would seem almost unnecessary to be obliged to allude here to such measures, yet the use of the penknife and the nail-brush are not always enough. Is it possible for a surgeon to go from the post-mortem room or from a case of erysipelas, or for a surgical teacher to be called from demonstrating on a cadaver to operating in the hospital or in private, without danger of carrying septic material? I think we are now in a position to say Yes, provided he disinfect his own hands and skin, and change his clothing. I know that I have, on numerous occasions, gone directly from a class demonstration on the cadaver to the hospital amphitheatre to operate, and seen patients recover without a sign of sepsis. But how is this possible? Under such circumstances, so far as the hands and forearms are concerned, I would advise to wash them first thoroughly in soap and water, using the nail-brush freely, then to take a tablespoonful or more of flour of mustard and wash the hands thoroughly with this, as if it were a powdered soap. Mustard is certainly an admirable deodorizer, and its essential oil has been shown to be a most valuable antiseptic agent. (This method will serve to disinfect the hands and deodorize them after handling any foul-smelling material or sanious discharge.) Now, before approaching the patient, no matter what may have been done before, aside from the ordi-

nary scrubbing I would highly recommend the use of the sapo viride (G. P.) to which has been added 5 per cent. of lysol, creolin, or hydronaphthol. Hands and forearms should be thoroughly scrubbed with this, then rinsed and immersed in strongly colored solution of permanganate of potassium. They should then be rinsed again, and now immersed in a solution of oxalic acid, not too strong, and yet sufficiently so to decolorize the skin within two or three minutes. The oxalic solution may be rinsed off, and the hands may now be regarded as thoroughly aseptic. It is expected that occasionally during the course of the operation they will be rinsed in antiseptic solution. This, so far as personal experience goes, is a more reliable method than the use of turpentine or any such material upon the hands.

6. *Drainage materials.* For the most part these comprise horsehair, catgut, soft-rubber tubes, hard-rubber tubes, spiral or stiff glass tubes, and gauze strips or wicking. Views and practices concerning drainage have materially changed even since the antiseptic era began. Our predecessors drained to permit escape of pus which they knew would form. Until lately we have drained in order to prevent its formation. We seem now to be on the eve of an era when we need to drain but little or not at all. We resort to drainage now only of necessity, in septic or infected cases. In other cases we drain mainly from habit, or from fear. Indeed, when we start afresh, as it were, without previous infection, the practice of drainage is a confession of fear, or of weakness, both of which are alike unscientific and unfortunate. We have learned that a little blood serum is an advantage rather than a detriment, and we do not need to guard against its presence as we used to. It even seems to me that in many cases, where all other aseptic requirements have been met, we do much more harm than good by the use of drains. Did time permit, it seems to me that it would be justifiable to occupy some moments in a discussion of this single topic. As it is, I will simply justify personal conclusions by mentioning certain classes of operations in which at present I never resort to drainage—never having regretted discontinuing it:

a. Deliberate operations about the brain and calvarium.

b. Amputations when in uninfected tissues.

c. Excisions of joints for conditions other than tubercular.

d. Herniotomy, both for strangulation and radical cure, when the intestine is still viable and no gangrenous condition is met with.

e. Osteotomy, tarsectomy, and other operations for relief of deformity.

f. Most operations for removal of tumors, etc.

This is by no means a complete list, but is simply intended to be suggestive.

7. *Dressing materials.* Two questions come up here: What is the best dressing material? and what antiseptic is most suitable for the case?

Naturally wounds need some protection, and, inasmuch as in certain cases there will be at least a slight discharge of serum or blood, this protection must at the same time be absorbent, and the choice of the absorbent material may well be left to circumstances or to fancy of the surgeon. But the selection of an antiseptic is again a confession of distrust of one's self or of what has been previously done; and while such distrust may be in the interest of the patient, it is not in the direction of scientific advance. Consequently we may say that after the ideal aseptic operation we need only a sterilized and protective dressing—protection from the air without, as well as protection from contact contamination and from the restlessness of the patient. Such ideal dressing may be composed of any sterilized material. The majority of operators, however, desire some additional assurance, or an additional safeguard, which they may, perhaps, secure in the impregnation of the wound-dressing with any one of the more or less reliable antiseptic chemicals. These remarks do not pertain so much to a large group of cases where drainage must be resorted to, and where more or less discharge is necessarily expected. If dressings are to be saturated or much moistened with wound discharges, it is well that they should be charged with some soluble antiseptic. In certain cases the conditions of repair necessitate much purulent or puruloid discharge. It is well that this should be taken up by material which may antagonize its decomposition or putrifaction. Whether this material shall be some soluble salt of mercury or zinc, or something like iodoform, salicylic acid, zinc oxide, etc., is scarcely germane to our present subject; so long as the object aimed at is attained the possibility or probability of wound infection is prevented.

8. *Miscellaneous sources of wound infection.* These are almost too numerous to mention, but illustrative examples of sources of danger may be given as follows:

Drops of perspiration are liable to fall into the wound area from the forehead and face of an excited, fatigued, or hard-worked operator. So also may scales of dandruff from his hair or beard. The former will probably be seen, the latter not. Consequently the ideal operator in this respect is he whose hair is worn short, and whose face is devoid of beard. In almost every clinic are certain irrigator tubes and nozzles intended for daily use. It is quite possible for one of these to be used to day for washing out some old abscess cavity and to be then hung up until to-morrow, when it is used in a case about which pus has neither been present nor is expected to be. Infection may thus be carried from one to the other. It is my custom to disinfect these nozzles with strong solutions of permanganate of potassium, as also the hard-rubber atomizing tubes which I frequently use for spraying out wounds or washing off surfaces.

In many severe cases the surgeon is strongly tempted, sometimes im-

peratively impelled, to place his hand upon the patient's radial pulse. It has been suggested, and it certainly is good practice, to carefully disinfect the area of the patient's wrist before the operation, so that the operator can, if necessary, feel the pulse without the danger of thereby infecting his hands.

In every well-regulated clinic there are regulations with regard to clothing, and a supply of clean linen is furnished for the operator and his assistants. Some even carry this precaution to the extent of allowing no one in the room who is not thus clad in fresh linen, which will dislodge no dust upon contact. And who shall say that this precaution is not a wise one, even if, perhaps, sometimes superfluous?

Another source of danger, which I have not seen elsewhere alluded to, is one to which of late I have given some personal study. It is customary with many, after the wound is ready for its dressing, to anoint the surrounding skin with some unctuous material, which shall prevent such adhesion of wound-dressing as may make change of the same a source of dread to the patient. In my own clinic this is done almost as a matter of custom. It is quite possible for such ointments to come in contact with the wound; often they are deliberately applied over it. It behooves us, then, to know whether such ointments, which are supposed to be antiseptic, are such in effect. In the surgical clinic of the Buffalo General Hospital ointments containing 5 and 10 per cent. of naphthalin, of resorcin, and of hydro-naphthol are constantly kept on hand. These are made up in part with vaseline, to which lanolin is added. For the purpose of ascertaining in the first place whether the ointment material was or was not sterile, in the second place whether these ointments themselves were reliable, and in the third place whether the method of preparation with or without heat made any difference, a series of experiments has recently been made for me by one of my surgical assistants, Dr. E. J. Meyer, who is also well versed in pharmacy. Briefly, the results of these experiments have been as follows:

1. Vaseline and all other bases commonly supplied for ointments, as they come from the shops, are by no means free from bacterial contamination, the majority of culture experiments made with them being successful.

2. Ointments made with resorcin and naphthalin, even of 10 per cent. strength, prepared without heat, give for the most part growths of various bacteria.

3. Similar ointments made up by the aid of heat, where the temperature of the mass has been raised to the boiling-point of water, seem to be absolutely sterile, and when exposed to the air suffer only from air contamination, so far as found, with non-pathogenic bacteria and the common moulds.

I would regard these experiments as not only suggestive, but import-

ant, because they show that there is not enough diffusion of the antiseptic itself through the ointment mass to exert any such effect as has been generally supposed. Therefore, I assign this fact as illustrating another of the possible sources of wound infection from well-intentioned but misjudged and overestimated protection.

It is well to recall here the investigations of Liebreich, who claims that a coating of lanolin constitutes an almost impassable barrier for bacteria, keeping them in or keeping them out, as the case may be.

And now, without detaining you further, it is necessary that I should bring to a close a paper in which the endeavor has been made to be suggestive rather than complete. The particular features to which I would especially invite attention may be epitomized in the following conclusions:

1. Study of wound infection and of the septic condition thereby produced is inseparable from a study of what constitutes immunity.

2. By a study of immunity is furnished the best clue to a due appreciation of the principles of asepsis.

3. The surgery of the future must aim to be aseptic, for, so far as fresh cases are concerned, we have passsed the merely antiseptic era.

4. Asepsis is to be achieved, not alone by attention to the wound and the pharaphernalia of operation, but by the closest regard to the condition of the patient's organs and tissues.

5. Sepsis may arise from circumstances and conditions other than those pertaining to the wound itself, although hitherto practitioners have been too prone to scan solely this field when searching for its cause.

6. Sepsis and infection are combated in more than one way by natural agencies and by inherent properties of cells and fluids, totally aside from the measures which the surgeon institutes, and the wisest man is he who studies to take advantage of these vital activities rather than introduce new and conflicting elements from without.

7. A recognition of the power of chemotaxis possessed by organized and unorganized materials, in such varying degree, can be utilized to great advantage so soon as it can be reasonably clearly defined.

8. A study of chemotactic activity appears to impress one with the truth of the phagocyte doctrine, which, if proven, is one having a large bearing upon the principles as well as the practice of the surgery of the future.

9. The proteid material contained within cellular infectious organisms plays such a rôle, both in causing chemotaxis as well as in poisoning the animal infected, that we have reason to eagerly welcome all knowledge concerning it.

10. So fast as such proteid material can be isolated we need, among other things, to study its effects upon the commonly used antiseptic agents.

11. We need to study much further the anti-toxic and bactericidal properties of human blood serum, and the means by which we can avail ourselves of the same.

12. Some such classification as I have attempted to give of the various causes of lowered resistance to infection, or of the causes of *vulnerability* or susceptibility, will certainly assist in a due appreciation thereof, and will often aid in so fortifying the patient that he may resist infection to which he would otherwise succumb.

13. The condition of entero-sepsis, fecal toxæmia, stercoral intoxication, or whatever it may be called, is certainly one which every practitioner has to fear and against which he should assiduously guard. It is not sufficiently generally recognized and combated.

14. A sub-form of this condition might justly be made and be entitled gastro-sepsis, comprising cases where defective stomach digestion, often from dilatation, brings about a lithæmic or other toxæmic condition which favors infection.

15. Antiseptic agents in the past have worked a revolution in surgical practice and results. We have now reached a time when we know that they all have their disadvantages, and also understand how, if we are strictly aseptic in our work, we can afford to discontinue their application to wound surfaces.

16. But the insurance of the aseptic character of such work necessitates the use of antiseptic agents of some kind upon everything which may directly or indirectly come in contact with these surfaces.

17. When this work is strictly aseptically performed, the use of drains or further employment of antiseptics is either an expression of mental uncertainty or of fear. It may be in the interest of humanity, undoubtedly it often is, but it is not attaining the ideal of scientific work.

TWO CASES OF PREGNANCY WITH BRIGHT'S DISEASE AND ALMOST COMPLETE SUPPRESSION OF URINE.

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An obstetric physician cannot help being interested in the pathology of puerperal eclampsia. The theory of this disease which has the most reason in its favor is that the convulsions of puerperal eclampsia are caused in the same way as uræmia apart from pregnancy.

But the pathology of ordinary uræmic convulsions appears to me to scarcely yet rest on a firm basis. It seems generally accepted that

uræmic convulsions are a result of imperfect elimination of certain waste products that ought to have been got rid of by the kidneys. Various views have been put forth as to what these products are, where they are retained, what changes they undergo, and in what form they produce the symptoms of uræmia. But there seems to be agreement as to the fact that in health they appear in the urine, for the most part in the shape of urea.

I have not been able to find in any text-book which treats of kidney diseases any proof, or attempt at proof, or reference to proof, that uræmic convulsions are associated with deficiency either of urine or urea. But in conversation with physicians whose line of practice makes them specially familiar with renal disease, I find that the proposition that in uræmia the elimination of urea is diminished is to them a truism so repeatedly verified by experience that no one thinks that the publication of detailed evidence for its demonstration is needful. Doubtless, then, this view is correct. But I have quite failed to get, either from reading or from verbal inquiry, any information as to what *degree* of defect in the elimination of urea is sufficient to produce uræmia, or how long a great diminution must last before convulsions or other uræmic symptoms are produced. One would, of course, not expect that a very rigid limit could be laid down which should hold good for all cases, but surely some law must be capable of definition.

I have published in the *Transactions of the Obstetrical Society of London* (vols. xxix., xxxii., and xxxiii.) a series of twelve cases of puerperal eclampsia in which the urine was measured and the quantity of urea in it estimated. In every case it was found that while the fits were occurring there was diminution in the excretion of urea. These observations harmonize with what would have been expected if puerperal convulsions are uræmic, and the current conception of the pathology of uræmia is correct.

But there are observations which tend to show that the pathology of uræmia is not quite so simple as this. Carter[1] speaks of "the absence of convulsions so often characterizing the uræmia of absolute suppression in persons healthy up to the time of the suppression, of which probably most physicians have seen examples." Sir W. Roberts[2] says: "Sometimes, however, very great scantiness of urine, or even total suppression (in acute Bright's disease) may exist without evoking any uræmic symptom. In a case of scarlatinal dropsy related by Biermer complete suppression of urine continued for five days without uræmia; then followed a further period of four and a half days in which urine was secreted, but only in the scantiest proportions (a few teaspoonfuls a day), and yet no uræmia.

[1] Bradshaw Lecture "On Uræmia," Brit. Med. Journal, 1888, vol. ii. p. 466.
[2] Urinary and Renal Diseases, 2d edition, p. 421.

At the end of this second period the urine began to flow abundantly for a short time, and then again became scanty. Three days later uræmic coma set in, followed by convulsions, which proved fatal."

In the present communication I report a case in which there was almost absolute suppression of urine, lasting a week, and very great diminution in the amount of urine for two weeks; and the excretion of urea was diminished even more than in proportion to the quantity of urine, and yet there were no convulsions.

I report, also, another case in which the diminution in the quantity of urine was not so great as in the first case, and the amount of urea in it was only once estimated; but the flow of urine for more than a fortnight was far below the average of health, and below the quantity passed in some cases of eclampsia.

I refrain from any attempt at generalization, further than to say that Case I. and the case Sir W. Roberts quotes from Biermer seem to me to show that mere diminution of the excretion of urea in the urine cannot be *per se* the cause of uræmic convulsions.

CASE I. *First pregnancy: symptoms of renal disease coming on during the last three months; intra-uterine death of fœtus and premature delivery; almost complete suppression of urine for eight days after delivery; great diminution for two weeks; diminution of urinary solids and urea; albuminuria; vomiting; diarrhœa; œdema; delirium; pericarditis in third week after delivery; parotitis in fourth week; retinal hemorrhages; death eleven months afterward.* (From notes by Dr. Hugh Smith, resident accoucheur, and Mr. A. H. Smith, clinical clerk.)—M. A. McC., aged twenty-five. Admitted to the London Hospital October 29, 1889, under the care of Dr. Herman. Patient was a domestic servant, and remained in her situation until three months before admission. No previous illness, except smallpox when aged about twenty. First menstruated at fourteen. After the first appearance of the catamenia they ceased for six months, then returned, and from that time till her pregnancy she was regular every month, flow lasting two days, and being scanty and painless. Patient was not married, and the pregnancy was her first.

During the first three or four months of pregnancy patient suffered severely from vomiting every morning. At the beginning of the fourth month of pregnancy her legs began to swell. This swelling was as great in the morning as in the evening. About the sixth month she began to suffer from an enlargement of a vein in the right leg, and for this reason, and not because she felt ill in any other respect, she left off work. During the last three months her face was puffy. Three weeks before admission she noticed that her urine was scanty and dark-colored, and at the same time she had a slight aching pain across the loins. These symptoms lasted about six days. From that time until her confinement she had to get up three or four times in the night to pass water. The water was pale in color and she thought more than the usual quantity.

She was delivered of a stillborn child on October 28th. She thought herself about a fortnight short of full term. The labor was easy, only lasting seven hours. Immediately after delivery patient became very

restless, could not sleep, and was very thirsty. She passed no urine for fifteen hours after her confinement, when six drachms were drawn off.

Next morning (*October 29th*) she was said to have been feverish, thirsty, and somewhat delirious, and her sight became suddenly indistinct, so that she could only see the outlines of things, but not details. She was brought to the hospital and admitted.

On admission she complained of great pain across the loins and was very thirsty. She was pale and anæmic. Eyelids so œdematous that they could not be separated more than one-quarter of an inch; legs œdematous. Optic discs slightly swollen and outline indistinct, but no retinal hemorrhage in either eye. Sight bad; could count fingers at two feet distance with the right eye; at three feet with the left; could not distinguish faces. Heart's impulse strong and widely diffused. Loud and harsh systolic murmur heard over the whole cardiac area, but especially over the base on the left side. Pulse full, but compressible; 104 per minute. Has not at any time had headache; none now.

30*th*. At 6 P.M. on the 29th was dry-cupped over loins, and at 7 P.M. had a hot bath, which produced profuse perspiration. At 8 P.M. vomited, and some hemorrhage from the uterus took place. During the night was restless and did not sleep; slight apparent delirium at times.

31*st*. Patient had a hot-air bath last evening, and sweated freely while in it and for half an hour or more afterward. Loins were again dry-cupped, and this gave great relief, removing a persistent dull pain that had troubled her all day. Eyelids less œdematous than on admission. Is less thirsty. Last night was restless and a little delirious, wanting to get out of bed. No convulsions, nor anything like the premonitory symptoms of one. Is taking milk with lime-water, soda-water, and "Imperial," and tr. ferri perch. ♏x ter. die. There is occasional vomiting, which does not appear to be provoked by food or medicine. Bowels open five times in last twenty-four hours; motions loose.

November 1. Hot-air bath last night, which produced free perspiration. A retinal hemorrhage discovered this morning. Bowels open once.

2*d*. Bowels yesterday open thirteen times; motions loose. Troublesome vomiting of green, bilious stuff. Pulse less full. Murmur not so loud. Milk stopped; patient taking brandy and soda and iced water.

3*d*. Diarrhœa continues. Vomiting less frequent. No pain. Œdema less. Taking now about eighteen ounces of milk in the twenty-four hours with soda-water or lime-water. Ophthalmoscopic examination by Mr. Warren Tay: discs ill-defined, œdematous; numerous small hemorrhages in both eyes.

5*th*. Vomited yesterday. Pain in umbilical region complained of. Appetite bad. No headache. Restless. Œdema less.

6*th*. Some diarrhœa. Still very restless. Chloral last night, which gave some three hours' sleep.

7*th*. Hot-air bath last night; sweated freely. Also dry-cupped.

8*th*. Hot-air bath and dry-cupping repeated last night.

9*th*. Signs of neuro-retinitis more marked. Diarrhœa continues. No vomiting. No headache. Sleeps better. Œdema gone.

12*th*. A few moist râles at lung bases. Has been dry-cupped every other day, and had hot-air bath, in which she sweats freely. Still restless at night.

14*th*. Appetite improving; patient less anæmic. Still on milk diet.

15*th*. Vomited once. Complains of a sensation of something swelling in her head. Slight epistaxis.

16*th*. About 4.30 A.M. complained of oppression of breathing, which was relieved by sitting up, and a little brandy. At 10.30 A.M. respirations 38 per minute; complained of weight on the chest. Pericardial friction sound heard over a small area to left of sternum. Fine crepitations at lung bases, but no dulness. Patient looks ill; hands and nose cold.

17*th*. Breathing very distressed. Respirations 40. Pulse 120, small and compressible. Pericardial sound well marked.

20*th*. Breathing now easy. Pulse 104. Now no abnormal cardiac sounds. Patient seems better in every way.

21*st*. Left parotid gland swollen and tender; left side of face so swollen that left eye is completely closed. Temperature 100° last night, normal this morning. Pulse 114.

26*th*. Parotid swelling has disappeared. No pain. Last two days some hemorrhage from rectum, blood being intimately mixed with fecal matter. Pulse 120, very weak. Patient anæmic.

28*th*. Per rectum, some thickening and great tenderness on each side of uterus.

29*th*. Some clots passed per rectum. Last two days patient very drowsy. Still vomits once or twice daily. Is much wasted.

December 3. Patient still very drowsy, sleeping the greater part of the day as well as at night. Appetite bad. Frequent vomiting. Tongue red in patches; lips cracked. Since November 28th taking half a pint of beef tea daily, as well as milk diet. Last night vomited a clot of blood. Pulse small and weak.

7*th*. Vomiting continues. Anæmia marked. The largest of the retinal hemorrhages is nearly absorbed. Outline of discs clearer. Sight better; can read large type.

14*th*. Patient seems improving. Pulse 90; stronger than before. Tongue clean.

19*th*. Can read ordinary print easily. No nausea or vomiting for three days. Appetite good. Sleeps well.

27*th*. Has only vomited twice since last note. Hot-air bath and dry-cupping discontinued. Gets up for an hour every evening. Taking since December 13th ferri-amm. cit. gr. v, t. d. To have now reduced iron gr. iij three times daily.

28*th*. Breathing hurried and shallow; pulse 120. Loud systolic murmur at heart's apex.

30*th*. Dulness and râles at extreme base of each lung. Pericardial friction sound. Morning vomiting.

January 1, 1890. Friction sound still heard.

6*th*. Inflamed swelling over sacrum. Morning vomiting continues.

7*th*. Patient's weight this morning is eighty-eight pounds. She says that a year ago she weighed one hundred and twenty-nine pounds.

15*th*. There has been daily vomiting. Appetite not good; nausea after food. Anæmia very marked. Sight better; can read small print for a short time, but sight soon becomes misty. Heart distinctly hypertrophied; no murmur. Arteries tortuous and thickened.

29*th*. Vomiting rather less since last note. Weight now ninety pounds.

February 3. Swelling of optic discs has increased again, and there are some recent retinal hemorrhages.

10*th*. Weight now eighty-five and a half pounds. Is sick every morning; appetite bad.

March 5. Retinal changes more marked; fresh hemorrhages; peripheral atrophic patches. Patient cannot sew or read, or distinguish faces clearly at the distance of a few yards. Condition otherwise much the same. During the last week a good deal of sharp and severe headache. Slight puffiness of eyelids. Vomiting on most days. Is less anæmic. Weight eighty-four pounds.

April 8. Weight seventy-eight and a half pounds. Vomiting continues. Very little nourishment taken.

15*th*. Transferred to the care of Dr. Ralfe. She remained under his care until July 18th, when she was sent to a convalescent home at Brighton. She was again admitted under Dr. Ralfe's care on September 4th. She suffered much from dyspnœa, sleeplessness and vomiting, and died on September 29th.

Autopsy showed effusion into both pleuræ; pericarditis; hypertrophy of left ventricle; fatty heart; kidneys extremely granular, with lines of calcareous deposit in cortex; weight three ounces each. Liver normal.

Urine. Quantity: From the time of the patient's admission until December 23d (*i. e.*, nearly two months) the urine was collected at intervals of two, three, or four hours, but never less than four hours. If the patient did not herself pass water at these intervals, a catheter was passed. Some urine was unavoidably lost with the motions, and, as the patient had a good deal of diarrhœa, these were frequent. In women there is no practicable means of avoiding this source of error. But in the table the number of motions is shown; and it will be seen that the difference in the number of the stools before and after the augmentation of the amount of urine exhibited in the table is not sufficient to account for the difference in the amount of the urine collected. Although the diarrhœa prevents the observations from presenting an entirely accurate account of the renal function, yet it is not enough to explain the difference from the phenomena of health. There is error, but I do not think it material in amount.

During the first week, the amount of urine was so far below the normal standard that the diminution almost amounted to suppression. The average of the first eight days was two and a quarter ounces per diem. During the next five days the quantity increased, the average for these days being eleven and seven-eighths ounces per diem. During the first eight days the average number of motions per diem was seven and a half, and in the succeeding five days seven; so that the difference in the amount lost at stool is no explanation of the deficient quantity of urine at first. By the end of the period just mentioned the urinary secretion may be considered to have been restored to its normal quantity. In the second fortnight the daily average was thirty-six ounces;

third, thirty-one ounces; fourth, forty-seven ounces; fifth, fifty-nine ounces; sixth, fifty-four ounces; seventh, fifty ounces; eighth, thirty-eight ounces; ninth, forty-eight ounces. After this date it was not collected with so much care. The number of motions was not, after the first three weeks, recorded so accurately; but it will have been seen from the notes that the patient frequently suffered from diarrhœa, and yet the average amount of urine collected was rather above than below the average of health.

It may be suggested that the deficient quantity of urine was possibly due to deficiency in the amount of fluid ingested. To anticipate this, I have stated in the table the amount of fluid taken each day. It will be seen that this does not explain the scantiness of the urine.

Specific gravity: During the period in which the urine was so scanty the quantities collected were not large enough to allow the specific gravity to be taken with the ordinary urinometer. A specimen of October 30th, mixed with one of October 31st, gave a specific gravity of 1006. The specimens of November 3d mixed together gave a specific gravity of 1011. From November 8th onward, the specific gravity varied between 1010 and 1014. Therefore not only was the urine deficient in quantity, but the little urine that was passed was deficient in solid contents as compared with that of health.

Albumin: The quantity of albumin was measured by the eye when the urine had been allowed to stand after precipitation of the albumin. Throughout the whole of the patient's stay in the hospital the urine was albuminous. The quantity varied from a mere trace to half the bulk of the urine. Toward the end of the first week (the week of scanty urine) the amount of albumin was rather greater than at the beginning. But taking the average of various specimens, there was no great difference between the quantity of albumin at the time when the amount of urine was greatly deficient, and that when the secretion had been re-established. I am not able to point out any circumstances with which I can connect the minor variations in the quantity of albumin.

The extent to which the albuminous precipitate was composed of *serum-albumin* and of *paraglobulin* respectively, was estimated by separating the paraglobulin with sulphate of magnesia and filtering. There were great variations in the relative amounts in different samples on the same day, from causes which I cannot identify. But comparing broadly the relative quantities during the period of great diminution in the quantity of urine, with those after the reëstablishment of the secretion, there is a great difference. During the first week (that of scanty urine) the quantity of paraglobulin was never less than, and usually several times as much as, that of serum-albumin; and on three occasions the albumin was almost all paraglobulin. After the first week the quantities of the two kinds were sometimes equal, sometimes there was more serum-

albumin than paraglobulin, and sometimes there was no paraglobulin. Sometimes the paraglobulin was in excess; but there was never such an excess of paraglobulin as was repeatedly observed in the first week.

Urea: Not only was there, during the period of suppression, the deficiency in the elimination of urea which would have been expected from the scantiness of the urine, but the percentage of urea in the urine was much below the average of health, and below even what would have been expected from the specific gravity of the urine. It was estimated by the hypobromite process.

Day of month.	Day of puerperium.	Urine in ounces.	Urea in grains.	Percentage of urea.	Ounces of fluid taken.	Bowel movements.
Oct. 30	1st	2	5	0.7	110	2
" 31	2d	3	7	0.5	40	5
Nov. 1	3d	2	7	0.6	41	10
" 2	4th	3	8	0.7	36	9
" 3	5th	5½	16	0.7	34	9
" 4	6th	6	18	0.75	25	9
" 5	7th	4	14	0.8	34	5
" 6	8th	2	7	0.85	23	6
" 7	9th	12	50	0.9	35	7
" 8	10th	9	42	1.	37	7
" 9	11th	15	66	1.05	42	6
" 10	12th	14	70	1.05	43	9
" 11	13th	8	36	1.	43	9
" 12	14th	19	90	1.1	42	4
" 13	15th	25	114	1.05	43	6
" 14	16th	29	138	1.05	45	8
" 15	17th	42	212	1.1	58	6
" 16	18th	40	220	1.25	44	3
" 17	19th	39	239	1.4	46	3

On admission the percentage was only 0.7. The next day it fell to 0.5. From this date onward there was a gradual but slow rise till 1 per cent. was reached, on the tenth day. Then the percentage continued from 1 to 1.2 per cent. till the eighteenth day. On the eighteenth and nineteenth days there was a more rapid rise, reaching 1.4 per cent. on the latter day. After this, for the next month it was, on the average, about 1.5. From the combination of a diminished percentage of urea with diminished quantity of urine, the absolute amount of urea eliminated by the kidneys was for a fortnight surprisingly small. For the first ten days it averaged 17.4 grains per diem. The next five days show a slight increase, the average being 53 grains per diem. Then it rapidly rose until an average of 200 to 300 grains per diem was reached. The quantities subsequently were as follows:

Second fortnight, average			.	.	.	231 grains per diem.	
Third	"	"	.	.	.	187	" "
Fourth	"	"	.	.	.	198	" "
Fifth	"	"	.	.	.	215	" "
Sixth	"	"	.	.	.	265	" "
Seventh	"	"	.	.	.	163	" "
Eighth	"	"	.	.	.	146	" "
Ninth	"	"	.	.	.	155	" "

It must be admitted that error from the amount of urine lost at stool, unavoidable in women, makes these figures incorrect in the direction of being too low. In relating the quantity of urine passed I have discussed this source of error, and given the reason for thinking that not much urine escaped collection, and that therefore the figures here given are not *much* below the truth.

Deposit: Owing to the very small quantity of the urine, and to this being used for the estimation of urea, the urine was not often examined microscopically. But on the few occasions on which this was done no casts were found.

Briefly: We have here a case in which for eight days the patient passed only about three ounces of urine, and eliminated about ten grains of urea per diem; and yet there were no convulsions.

CASE II. *Eleventh pregnancy: symptoms of renal disease for at least eleven months; œdema; cough; vomiting; labor induced at six months of pregnancy; child living; death two weeks after delivery; no autopsy; urine loaded with albumin and containing casts; almost complete suppression of urine for ten days before admission; for a week after admission urine averaging a little more than three ounces per day; gradual but incomplete reëstablishment of the secretion until three weeks after admission, when labor was induced; after delivery rapid increase in quantity of the urine.* (From notes by Mr. A. F. Peskett, resident accoucheur, and Mr. Cornish, clinical clerk.)—I. R., aged forty-two. Admitted into the London Hospital May 23, 1885. Patient was a street hawker, and had always lived much out of doors. Had taken stimulants freely, mostly rum or gin. Had occasionally suffered from rheumatic pains, but otherwise had had good health until the present illness began. Was married at sixteen, and had had ten children, the last six and a half years ago.

Two years and a half ago she ceased menstruating for two months, then hemorrhage began and lasted ten weeks. She attended for six weeks as an out-patient at the Metropolitan Free Hospital, and got better. Three months after this she found her legs swelling. She went to St. Bartholomew's Hospital, was treated as an out-patient for five weeks, and got better. From this time she continued well until eleven months ago. Then she noticed that her legs were swelling, that her urine looked bloody, and that she had to pass it oftener than she had been accustomed to. She often had shooting pains in the lower abdomen and back. She menstruated the week before Christmas, and she believed herself to be pregnant. For ten days before admission she had passed hardly any water, not more than a teaspoonful at a time.

State on admission: Patient was fairly nourished, and not anæmic. Complained of epigastric pain and flatulence. No enlargement of liver or spleen. Heart's apex-beat in normal position; area of cardiac dulness not increased. Systolic murmur at apex, conducted toward axilla. Arteries rather hard. Breathing rather hurried and labored; bronchial râles over the chest; cough and expectoration. Ophthalmoscopic examination shows nothing abnormal; no retinal hemorrhages or retinitis. Patient complains of severe frontal headache. Abdominal wall and legs œdematous. Uterus reaching to umbilicus.

The catheter was passed on admission, and the night and morning afterward, but only a few drops of urine were obtained each time. All the urine passed or drawn off was collected and measured.

Pulv. jalapæ co., ʒj, was given on the morning following admission, and acted well. Patient was also given pot. acet. ʒss, liq. amm. acet. ʒj, spt. æth. nit. ♏xx, three times a day. In the evening of the day after admission she had a vapor bath, and perspired a little after it. Three times during this day the loins were dry-cupped. The next evening (May 25th) the vapor bath was repeated. On May 26th one-twelfth grain of pilocarpine was administered subcutaneously, and the dry-cupping and vapor bath were repeated. A mustard poultice was applied to the loins, and this was repeated on May 27th. On the evening of May 29th patient had a warm bath, and one-twelfth grain of pilocarpine was given subcutaneously, and these measures were repeated every evening until delivery.

Until June 9th the patient's condition appeared to be steadily improving. The cough and shortness of breath were getting better, and the œdema becoming less. There was throughout occasional vomiting. Pulse was throughout about 76 per minute. The temperature never exceeded 99°.

On June 9th and the following days the patient's breath became shorter, her cough and vomiting more troublesome.

Therefore on June 12th it was decided to induce labor. This was done by the introduction of a bougie between the membranes and the uterus. The patient was delivered on June 14th of a six months' fœtus, which lived about two hours.

The patient died on June 29th; no autopsy was allowed.

The urine was tested on May 24th, June 1st, 8th, and 18th. On the three first occasions it was smoky in color, and loaded with albumin. Its specific gravity on June 8th was 1013, on June 18th 1012. On the two first occasions it contained a deposit of epithelial and blood casts; on the two later, phosphatic crystals. There was no sugar. The urea was estimated on June 8th, by the hypobromite process, and was 0.6 per cent. Its reaction was acid or neutral throughout. The quantities collected are shown in the table which follows. Some was unavoidably lost with the motions, therefore the number of motions each day is also given, so that an idea may be formed of the amount lost.

It will be seen that although the very small quantity of urine may be partly accounted for by assuming that some was lost with the motions, yet that there is no such difference between the number of motions per day in the first week and afterward, before delivery and after, as can account for the great difference in the quantity of the urine at these different periods.

May 24	1 ounce.	2 motions.		
" 25	3 ounces.	3 "		
" 26	1½ "	3 "		
" 27	1½ "	6 "		1st week, average per day, 2.9 ounces.
" 28	6½ "	7 "		
" 29	3 "	9 "		
" 30	4 "	6 "		
" 31	2 "	5 "		
June 1	4 "	5 "		
" 2	4 "	2 "		
" 3	10. "	4 "		2d week, average 5.8 ounces per day.
" 4	6 "	3 "		
" 5	8 "	3 "		
" 6	6½ "	3 "		
" 7	6 "	3 "		
" 8	10 "	3 "		
" 9	10 "	1 "		5 days before labor, average 12 ounces per day.
" 10	17 "	6 "		
" 11	18 "	5 "		
" 12	2½ "	4 "		Bougie introduced. Collection
" 13	6½ "	3 "		this and following day im-
" 14	28 "	6 "		Delivery. [perfect.
" 15	20 "	3 "		
" 16	10 "	3 "		
" 17	33 "	4 "		Week after delivery, average 25.2 ounces per day.
" 18	30 "	3 "		
" 19	40 "	1 "		
" 20	20 "	5 "		
" 21	28 "	4 "		
" 22	30 "	3 "		
" 23	30 "	2 "		
" 24	24 "	4 "		
" 25	30 "	4 "		2d week, average 29.3 ounces per day.
" 26	35 "	3 "		
" 27	32 "	2 "		
" 28	24 "	2 "		

Both in this and in the former case, the diminution in the quantity of urine was far below what has been observed in some cases of eclampsia.

In this case, on the unfortunately few occasions on which the urine was examined, the specific gravity was found (as in Case I.) less than normal, and the percentage of urea even less than would have been expected from the specific gravity of the urine.

Seeing how powerful a diuretic urea is, may not the explanation of the suppression of urine in these and similar cases possibly be a deficient formation of urea? This would account for the small quantity of urine, the deficiency of urea in it, and the absence of so-called uræmic symptoms.

ASEPTIC AND ANTISEPTIC DETAILS IN OPERATIVE SURGERY.

By Arpad G. Gerster, M.D.,
of New York.

Though it must be conceded that the process of evolution of the principle which underlies safe operating is a closed chapter in surgery, yet it cannot be denied that means have lately undergone change, and

are still undergoing improvement. The main feature of this improvement is the simplification of our procedures. And simplification means an easier comprehension, a more ready acceptance by the general practitioner, and a beneficial spread of the practice of aseptic and antiseptic measures.

One of the most interesting features of the birth and infancy of the Listerian idea was the circumstance that this vast practical revolution in surgical management was based on purely scientific facts, seemingly of mere theoretical interest. I refer to the use made by Lister of Pasteur's researches. To one familiar with the character of these researches, it will be very natural that Lister's first steps in practically establishing the value of Pasteur's results were dominated by the idea of the necessity of chemical sterilization, or, as it was then called, disinfection. How strong and persistent the hold of this thought was upon the minds of men is best illustrated in the remarks made by Lister himself in a lecture or paper delivered not very many years ago. In those days Volkmann taught that in preparing the field for an operation, shaving and scrubbing of the skin ought to precede the application of the carbolic solution. Lister deprecated these measures as over-zealous and unnecessary, and if the printed report can be trusted, the tinge of a sneer was not mistakable in his critical observations. He contended that the great efficiency of carbolic lotion and spray made these plainer methods of disinfection superfluous. Of course, I must add that since then Lister has changed his position.

As a matter of fact there is no doubt now that the powerful action of the razor, of soap, and a stiff brush, goes far beyond anything that can be accomplished in the way of disinfection, even by the strongest permissible antiseptic. We know that, beside the filth adhering to them, epidermis and hair contain not only hosts of harmless and noxious germs, but that epidermis, hair, and clinging filth are all by necessity or accident more or less coated and permeated by various oleaginous substances which form an effective barrier to the penetration of all watery solutions. Hence, to insure the penetration and imbibition of a chemical sterilizer contained in a watery solution it is first necessary to remove this coating of grease. And what agent is better capable of doing this effectually than emollient potash soap, applied with plenty of hot water and the thorough action of a stiff brush made of the bristles of the hog? Grease, filth, and effete epidermis, harmless and pathological germs, are swept away all alike, rapidly and thoroughly, and with admirable impartiality. When the germicidal lotion is finally applied to the cleansed skin, there is very little to kill in the shape of noxious organisms. Lack of time forbids my entering into the scientific demonstration of the facts just related, but I refer those interested in the proofs of the inhibiting effect of oleaginous substances upon the action

of aqueous disinfectants to the conclusive article of Schimmelbusch.[1] Far be it from me to depreciate the value of the experiment which demonstrated that a noxious germ finely distributed in a generous quantity of water, to which was added a powerful germicide in a certain minute proportion, would promptly succumb to the deadly influence of this chemical. I only desire to point out the fact that these noxious organisms are not met with in the shape of thin, watery emulsions by the surgeon, but are found imbedded in dense masses of what Lister appropriately called "lumps of dirt," in conglomerations of grease and epidermis, in powerful plugs of sticky slime, pus, and blood-clot. Therefore let us *first* emphasize the paramount antiseptic value of the homely methods employed for cleansing dirty surfaces comprised in the term of *mechanical purification;* and *secondly* point out how infinitely more they accomplish than any form of chemical disinfection by watery germicidal solutions alone. Both should be combined.

Next in importance to the cleansing of the field of operation stands the question of the sterilization of the hands employed at an operation. Both Kuemmel[2] and Fürbringer[3] have brought abundant experimental proof of what enormous quantities of truly pathogenic germs are habitually lodged under the finger-nails of even the most cleanly persons, and especially of physicians. It matters not how often their hands were washed with soap and brush, the scrapings of the finger-nails always contained an abundance of noxious germs. We know that to facilitate digital examination, the surgeon's finger is lubricated with oil or vaseline. Not inconsiderable quantities of oleaginous matter intermixed with pathogenic bacteria persistently cling to the deepest recesses of the subungual space, and this fatty deposit prevents the effective penetration of germicidal lotions. Fürbringer's investigations have shown that the following process will invariably render the surgeon's hands germ-free: The nails should be kept trimmed short; the hands are to be scrubbed with brush and soap in hot water for one minute, especial attention being paid to the subungual spaces, which then are to be scraped carefully with a nail-cleaner, the hands to be immersed for another minute, first in strong alcohol, then in a 1 : 1000 solution of corrosive sublimate. Even hands that were in prolonged contact with intensely septic matter can be instantly rendered reliably aseptic by this process. This is comforting for the surgeon to know, who during the progress of an operation may be compelled to insert his finger into the rectum or oral cavity for the sake of necessary verification.

When my thoughts revert to the old days of spray and unlimited

[1] Archiv für klinische Chirurgie, 1891, p. 129.
[2] Centralblatt für Chirurgie, 1885, Beilage zu No. 24, p. 26.
[3] Idem, 1888, p. 83.

carbolic acid, the first thing remembered is the habitually shocking condition of our hands. Martyrdom means testimony, and the martyred state of our hands bore shining testimony of the earnestness of our faith. We all believed in the necessity of unlimited chemical sterilization, especially as to our instruments. Fortunately, all this has been changed for something better, and this we owe to Davidsohn,[1] who taught us to sterilize instruments by boiling.

But let us first examine whether the usual steps of the mechanical cleansing to which surgical instruments are subjected are adequate or not. That they are very important is very evident, inasmuch as by them is removed the bulk of blood, pus, shreds of animal tissue, and ointments clinging to their interstices and rough surfaces after an operation. Yet even the most thoroughgoing scrubbing in hot water with soap and a stiff brush will not render instruments aseptic. Schimmelbusch[2] has subjected instruments thus cleansed to bacteriological examination. He found that especially to artery forceps a considerable quantity of noxious germs were constantly adherent, and that only the simplest instruments were irreproachable.

Another factor has to be considered. In the large practice of our hospitals, where from three to five operations are performed at one session, the minute cleansing of a large instrumentarium after each operation is tedious, involving considerable time. We either had to submit to this, or had to provide a disproportionately large and costly set of duplicates and triplicates. As a matter of fact, the latter thing was rarely resorted to, and the cleansing of the bloody instruments being hurriedly and often inadequately done, main reliance was placed upon the disinfecting power of our carbolic acid bath. And as consideration for the assistants' hands had gradually caused the abandonment of the stronger for weaker solutions, frequent failures in securing primary union were the result of these evasive attempts.

As mentioned, Davidsohn demonstrated that boiling for five minutes in a covered vessel charged with water was invariably followed by a faultless sterilization of instruments thus treated. But the great drawback of this plan was that all steel objects thus treated, unless they were perfectly protected by nickel-plating, became rusty and were sooner or later ruined. This objection does not apply to its full extent to sterilization by superheated air; but the necessity for costly apparatus and the tardiness of the process[3] make this plan evidently impracticable. Sterilization by steam presents the drawback of rusting in a still greater degree.

[1] Berliner klinische Wochenschrift, 1888, No. 35.

[2] Loc. cit, p. 147.

[3] Poupinel: "La sterilisation par la chaleur," Revue de chirurgie, 1888, p. 669.

If we then had some reliable means of safely preventing the inroads of rust upon our instruments during sterilization by boiling, we would possess a rapid, simple, and thoroughly practical way of accomplishing our purpose. Common washing-soda, as found in every household, if added in the proportion of one per cent. to water, is endowed with the valuable property of preventing the formation of rust on steel during boiling. And we owe this expedient to the ingenuity of Schimmelbusch.

Let me now practically illustrate in another direction the vast importance of this simple, rapid, and reliable manner of cleansing instruments. It must appeal with peculiar strength to the sensibilities of the general practitioner and country surgeon. Look at the ordinary surgical pocket-case, containing the chief and often only available instrumentarium in a grave case of emergency. Its leather and lining are well worn and more or less soiled, both from long use and the necessity of carrying it about with us in hot and cold weather, rain and shine. Bathed in the vapors of perspiration, freely accessible to dust and dirt, it soon becomes the very negation of what is tidy. Imagine that a fresh case of compound injury to bone or joint, vessel or tendon, has to be dealt with, and that at once. Under these circumstances the instruments drawn from the pocket-case were always employed by me with much reluctance and no little trepidation. Only when the case brooked absolutely no delay and could not be tided over by temporary expedients permitting postponement of the operation to a safer occasion, did I operate. The cleansing that could be bestowed on such instruments on such occasions must needs be inadequate, and one had no choice but to trust to luck.

How different matters are, when we know that to put our instruments in a perfectly aseptic condition we need only a covered pot of boiling water charged with washing-soda, one tablespoonful to the quart. After five minutes of ebullition the contents of the pot, instruments, water and all, are emptied into a clean pan, and the operation may proceed.

In hospitals a sufficient supply of cold sterilized soda solution can be kept on hand, to be poured over the hot instruments as soon as they are placed in the instrument tray. Lately we have used at Mount Sinai Hospital simple boiled water for this purpose, with perfect satisfaction.

In recapitulation, we will say that instruments should be first cleansed with soap, water, and brush, then boiled for five minutes in a covered vessel containing a watery solution of washing-soda 1 : 100 (one heaped tablespoonful to the quart).

We have seen, from the preceding remarks, how important a rôle is played in modern surgery by the humble scrubbing-brush. And yet there is no other implement so generally neglected as this, and none that receives less care in practice. In hospital and the private office we see the brush used indiscriminately on the hands of the surgeon, the skin of

the patient, in close contact with vaseline, feces, urine, sputa, blood, pus, ichor, and what not. After use it is deposited on the washstand without any special care as to the removal of filth clinging to thousands of bristles and their interstices. It is no wonder that brushes thus treated become very hotbeds of infection.

Various expedients were employed to overcome this obvious evil, among which shall be mentioned first the exclusive use of new brushes in the preparation for each major operation, especially laparotomies; then the disinfection of brushes by continuous immersion in strong sublimate of mercury solution, and finally, the rejection of all brushes and employment of bundles of excelsior instead, which are thrown away after each single use (Neuber).

On account of its great effectiveness the banishment of the brush could be viewed by the surgeon only with regret. Hence let us examine whether a simple and practical way has not been devised to keep this implement clean.

I have again to refer to Schimmelbusch,[1] who has shown beyond any reasonable doubt, that a single and brief immersion in a strong germicidal solution is inadequate to destroy the noxious forms of bacteria contained in surgical nail-brushes. He found that brushes used in the wards and private rooms of the Berlin clinic, which were simply kept in the stereotyped dish alongside of the wash-basin, literally swarmed with pyogenic organisms. Further, he established that to satisfactorily disinfect a brush containing pathogenic germs, an immersion in strong mercuric solution of at least ten minutes was indispensable. If we consider how often brushes fresh from use on infectious cases and still filled with soapsuds are thrown back into the vessel set aside for their immersion, there to give up their contents of soap, which render the sublimate solution inert, we must conclude that under such circumstances even fifteen or twenty minutes will not accomplish a perfect sterilization. Hence we see with pleasure the demonstration of the fact by Schimmelbusch, that boiling of the most unclean brush for five minutes in a 1 : 100 soda solution will always render it absolutely aseptic. Ordinarily, then, surgical brushes should be always kept immersed in a 1 : 1000 sublimate solution, and should be always boiled before laparotomies, or whenever intensive infection has occurred. Finally, brushes carried about in the open satchel of the surgeon, or those found on the washstands of patients, should also be boiled before use.

Whenever I have watched the process of impregnation of our absorbent dressings, as it is carried on at our large hospitals, I could not avoid the feeling of uncertainty regarding the desired result. The repeated

[1] Loc. cit., page 161.

handling of large quantities of material by a certain number of persons required in folding, immersing, wringing, unfolding, drying, refolding, cutting, and final storing, cannot but impress the observer with the suspicion of contamination. Add to this the mistakes made in mixing the solutions used for impregnation, and the resulting over- or under-charging of the dressings with chemicals prone to evaporation or chemical change, and it will be seen that impregnation itself is apt to be very uncertain as to its absolute value. As to the merits of the processes employed by various manufacturers in preparing disinfected dressings, I will only remark, that as their gauge of success is a purely commercial one directed solely to profit, the work being done by persons to whom the essence of a surgically clean procedure is a matter of utter indifference, their trustworthiness must be a factor not amenable to direct proof and demonstration.

But let us see wherein dwells the antiseptic property of our surgical dressings. Can is be the inconstantly represented chemical agent, which even if present in the prescribed quantity, is nearly inert, or is it some other factor? The answer is that we know that the high antiseptic value of our intensely absorbent dressings depends on their quality of favoring rapid evaporation, rather than on any chemical properties they may possess. The curing of meat and fish by exposure to the sun is one of the most ancient preservative processes, and well known to be highly effective. As to the effect of evaporation upon pathogenic microbes, Schlange[1] has shown that the bacillus of green pus, for instance, inoculated upon moist pads of cotton—was aggressively prolific if kept under a glass cover which prevented evaporation. On the other hand, its proliferation was immediately checked if the pads were freely exposed to air and became dry by the loss of moisture. I cannot but fully indorse the statement made by Schimmelbusch, that the effectiveness of highly absorbent and rapidly drying dressings, even if they contained a moderate amount of schizomycetes, is much greater than that of materials which, however faultlessly impregnated, are lacking the properties just mentioned, as, for instance, Lister's resinous gauze.

Looking aside from the objectionable and unreliable features of impregnation itself, let us not forget the disagreeable influence of the chemicals used in this process upon the skin of surgeon and patients. The intensive eczema so frequently produced underneath our sublimate and carbolic dressings is a serious drawback of not small moment.

All these objections vanish if preference is given to one or another mode of sterilization by dry or moist heat. Of these modes only three need to be considered.

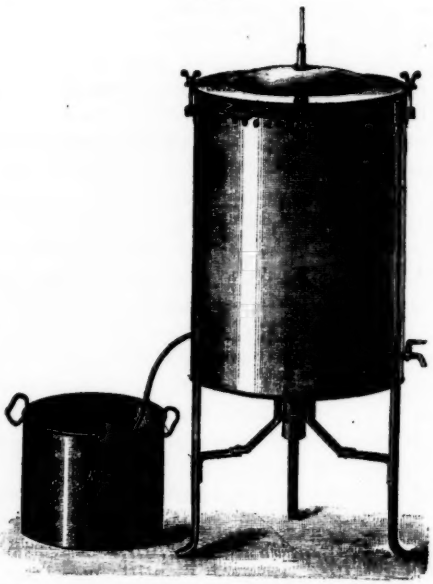
First comes the simple process of boiling. For purposes where a reli-

[1] Archiv für klinische Chirurgie, 1887.

able dressing has to be procured, *extempore* boiling in a soda or potash solution of about 1½ per cent. for ten minutes is incomparably the simplest and most practical manner of getting an absorbent and aseptic material. In this procedure we recognize at once the familiar ways of the laundry, the eminently aseptic results of which have been demonstrated beyond any reasonable doubt by Behring[1] in the Berlin Hygienic Institute. Thus cotton or linen stuff, to be found in every household, can be rapidly rendered serviceable for surgical purposes by a short boiling in soda or potash lye. Well rung out, it can be immediately used, and will dry rapidly *in situ* under the influence of the body-heat and exposure to the air.

Sterilization by hot air has also been shown to be sufficient, and would deserve serious attention but for the necessity of employing costly and complicated apparatus.

FIG. 1.



Lautenschläger's apparatus for the sterilization of dressings by steam.

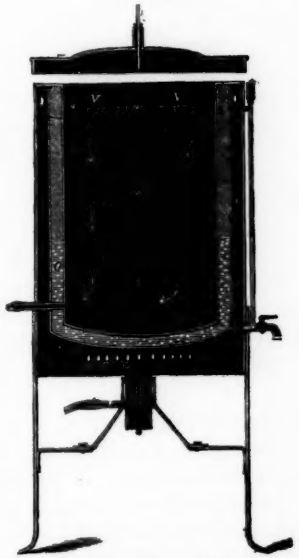
But these objections do not prevail as to a steady current of slightly superheated steam. The apparatus needed for this purpose is simple, cheap, and durable, and as I have ascertained during an extensive tour of investigation, embracing a considerable number of Continental clinics,

[1] Zeitschrift für Hygiene, 1890.

has been and is there universally employed with unvarying satisfaction. The apparatus I refer to is made by Lautenschläger, in Berlin, from plans by Schimmelbusch, and has several features to commend it. First, its moderate cost, easily afforded by every hospital, and even a busy surgeon. Secondly, the absence of the danger of explosion, the rapidity with which it is set in motion, and the thoroughness with which every fibre of the articles placed within it is permeated by steam, which enters the receptacle containing the dressings from above, displacing all atmospheric air, finally escaping through a tube at the bottom of the apparatus, whence it is conducted into a pail of cold water to effect its precipitation.

Another ingenious feature of this apparatus consists in the employment of a number of perforated tin boxes, which can be closed at will, each of

FIG. 2.



Sectional view of Lautenschläger's steam sterilizer.

these containing everything that is to be used at a given operation. Supposing that three operations are to be done, one after another, three of these boxes are charged each with all the dressings, towels, and surgeons' gowns to be used on that occasion, and are placed within the steam-chamber of the apparatus. The flames are lighted, and counting from the time that the thermometer connected with the apparatus indicates 100° C. the contents are exposed to the action of steam for forty-

five minutes. After this the boxes are taken out, their air-holes are closed, and the dressings in them remain clean and undefiled by any contact until the moment when they are taken out and applied to the wound.

Protected from all undesirable contact by the tin case, aseptic dressings can be thus transported anywhere, to be used wherever occasion requires. I need not add that gauze or cotton is not rendered absorbent by steaming alone, and must possess this property before sterilization. This apparatus was recently acquired for Mount Sinai Hospital, New York, where it can be inspected.

Dressings thus prepared possess all the requisites demanded by modern surgery. They are cheap, aseptic, can be kept so indefinitely, and do not irritate the skin.

FIG. 3.

Schimmelbusch's box within which dressings are placed in steam chest of sterilizer. *a* and *b*, air-holes.

The sponge is a surgical requisite so full of excellent qualities that no substitute has as yet succeeded in displacing it. A very good article, known as the Florida sponge, can be bought here for such a trifling sum that we can easily afford to use a sponge but once. Among the many processes recommended for its disinfection, that by boiling is to be absolutely condemned, as it robs the sponge of its most valuable properties—its softness, elasticity, and power to absorb. One of the most effective processes has been abundantly tested by myself in hospital and private practice for seven years, and these are its simple details: The sponge is to be freed of its calcareous impurities by dry beating and a short immersion in standard dilute muriatic acid. Traces of the acid having been washed away, the sponges are left for two days in water to give the spores contained in them a chance to germinate. The reason for this is the fact that proliferating microbes succumb much more

promptly to germicides than their spores. After this process of fermentation the sponges are thoroughly kneaded by hand, each for a minute, in plenty of hot water and potash or soft-soap, which will thoroughly macerate and mollify hard lumps of dirt that may be imbedded in the densest and central parts of the sponge, thus rendering them, as it were, penetrable to the action of germicides. After all traces of soap are removed, the sponges are thrown into a five per cent. solution of carbolic acid, which I prefer to corrosive sublimate for this purpose, as it does not become inert as easily as a metallic compound. An immersion extending over twenty-four hours will render the sponges absolutely sterile and fit for use. Should it for economic reasons be desired to use sponges oftener than once, this same process will be just as effective to purify them.

The large flat sponges so generally used in laparotomy have been abandoned by me for three years as expensive, and not as handy as small, well-sterilized compresses of plain absorbent gauze, which, to prevent unfolding and fraying, are firmly tied with silk at one end. The surgeon is nowhere so cramped for lack of space as at his operations in the bottom of the pelvis. A sponge used for packing away intestines needs constant pressure to prevent its expansion and encroachment upon available space. A pad of gauze held down for a short while will become packed, and will retain its shape and position even if released from digital pressure.

When I approach the vast subject of *operative technique*, indissolubly connected with the principle of asepticism and antisepticism, I confess to a feeling of helplessness. Hours would be required to do justice to the intimate connection and interdependence of these subjects, and I must content myself with giving you a few glimpses only. The enormous increase in the ratio of safety in operating caused by anti-parasitic measures has led to curious results. A clumsy and rough operator who is a thorough antiseptician is often very successful. On the other hand we see very dexterous men suffer disheartening discomfitures on account of disregard of the maxims of cleanliness. This is not said to encourage clumsy operating. On the contrary, I must declare what all of you know already, that the most brilliant triumphs of surgery are won in these days by those who combine technical skill, the cunning of hand and brains, with the conscientious practice of a thoroughgoing cleanliness. The neglect of cleanliness will meet in no field of human activity with a swifter and more certain retribution than here; hence I may say that cleanliness is one of the most important and truly ethical factors in the honorable pursuit of our noble art.

The barbaric elements of the neglect of cleanliness and inattention to hemorrhage, the rough methods of evulsion, the slashing and tearing,

often made necessary in former days by the absence of anæsthesia, have almost all been eliminated from surgery. Dissection is made safe by adequate incisions and by the control of hemorrhage, which keeps the field of operation comparatively dry. By the skilful use of retractors the track of the knife is laid bare to the scrutiny of the eye; and blunt methods of severing tissues being avoided wherever possible, clean-cut surfaces are left behind, more prone to heal than bruised and torn ones.

The immediate effect of anti-parasitic principles upon the improvement of operative technique is nowhere more evident than in those procedures where internal sources of infection are encountered and set free during an operation, as, for instance, in the excision of tuberculous, suppurating joints and glands, in the removal of the diseased appendix vermiformis, the evacuation of the intra-peritoneal abscesses, and the excision of suppurating abdominal tumors. To prevent accidental contamination of healthy surfaces, or, if unavoidable, to neutralize its bad effects, can be truly said to be a newly developed art. I may also mention the enormous progress in the safety of surgical interference in operating upon organs that can never be called aseptic: as, for instance, the rectum; the oral cavity—in fact, the entire digestive tract; the bladder, and the uterus. Here operative technique in the old sense, and antisepsis or asepsis, are so intimately blended that they cannot be safely separated, and ought to be taught together by book and example.

To illustrate the meaning of these remarks, I may be permitted to mention a few examples. To insure the success of an extensive excision of the rectum for cancer, we perform preliminary colotomy. Thus we divert feces and contamination from the field of operation, rendering it aseptic as far as possible. Likewise we open the membranous portion of the urethra and pass a drainage-tube into the bladder, in order to prevent the infection of a urethroplasty wound by ammoniacal urine. Not long ago, in performing a needful herniotomy upon a boy-child, I have, to prevent the soiling of the wound by urine, performed external urethrotomy with success. All these operations represent improvement of operative technique in a wider sense.

The field we have here touched is one where a clear line of demarcation between aseptic and antiseptic measures cannot be drawn. In many of the cases belonging to this order, *irrigation* is an important element of success; therefore let us devote a few words to the subject of irrigation.

The wholesale condemnation of irrigation as employed in the past is just as sure a sign of superficiality on the part of the critic as the slighting of the important rôle of antiseptic agents in former periods of the antiseptic method. As long as the preparatory measures to an operation were rather perfunctory; as long as the skin, the surgeon's hands,

his sponges, instruments, and dressings were indifferently cleansed, the continuous use of disinfectants during and after the operation was necessary to insure success—that is, to ward off virulent suppuration. Similarly, under those conditions, the use of continuous irrigation during operations was justified by the general improvement of results observed after its employment. As we have learned to lay greater stress upon and practice a more exact form of preparatory asepsis, so the necessity for chemical germicides and irrigation has been restricted. But both of these agents have furnished a valuable and necessary link in the chain of development of the discipline. This view is confirmed by the fact that practical experience tells us how indispensable irrigation still is to the safe performance of many operations done in regions which can be rendered and kept aseptic only with great difficulty or not at all. Here, too, the mechanical effect of the stream of irrigating fluid is infinitely more important, in my opinion, than the chemical influence of the weak solutions generally used. It is rather the rush of the fluid washing away impurities than the salicylic or boric acid dissolved in it that is effectual.

Accordingly, we rarely employ irrigation in wounds that are known to be free from infection, and with few exceptions never take strong solutions, the use of which has produced in the past a considerable number of fatal intoxications. By eschewing chemicals we also have seen hæmostasis become easier, and especially have observed that the troublesome oozing of the fresh wound has been almost entirely done away with. Our dressings grew less bulky and cumbrous; they could be left longer undisturbed, and, what is an important item in the amputation of limbs, could be bandaged on with less pressure, whereby the danger of marginal necrosis of the flaps is materially diminished. In short, the dryer the operation, the dryer was the course of healing. How this matter has affected the question of drainage we shall consider presently.

To sum up we shall say, then, that irrigation of an aseptic wound is unnecessary, even harmful; that it should be only employed in wounds which are *per se* not aseptic, such as those in the vicinity of or within the several orifices of the body—as, for instance, the rectum, oral cavity, and vagina; that irrigation is well employed during operations in and about accidentally infected or suppurating areas. *A notable exception to this rule is the abdominal cavity, wherein irrigation is never to be employed.* This statement seems to condemn a widely spread practice, and some courage is needed to express it unreservedly. But both experience and scientific experiment support this view. It will be objected that a vast array of cases is on record wherein irrigation of the abdominal cavity was practised successfully by eminent surgeons. To this we reply, that where harmless substances, as, for instance, blood, non septic

contents of cysts, or abacteric pus from a ruptured pyosalpinx or ovarian abscess, have accidentally soiled the peritoneum, the simple wiping off of the bulk of these substances is sufficient to eliminate danger; that in these cases irrigation is unnecessary, and that recovery takes place rather in spite than in consequence of irrigation. How entirely useless, nay, pernicious, the effects of flushing the peritoneum are in cases of active septic infection, as, for instance, in the presence of fetid fecal abscesses due to intestinal perforation, has been abundantly demonstrated to myself and to other surgeons here and abroad by numerous unsuccessful attempts. And there is nothing more certain than that, on account of its complex character, the peritoneal cavity cannot be completely washed clean; that germicidal solutions cannot be used in a sufficient strength to be effective, and that finally an inert or weak solution will only help to spread the elements of infection to previously unaffected areas. The substance of these assertions was essentially confirmed by experimental research on animals.[1]

I take this opportunity for a short diversion to a subject still discussed by surgeons and deserving some notice. Most operations within the peritoneal cavity afford no very rigid test of the absolute value of the aseptic measures therein employed. The tolerance of the peritoneum is almost incredible, and technical sins committed during abdominal operations against the accepted rules of cleanliness, proper dissection, hæmostasis, go much oftener unpunished than those incurred at an amputation, resection, osteotomy, or the excision of extra-abdominal tumors —in fact, at all major operations performed outside of the belly. But let the limits of peritoneal tolerance once be overstepped and usually the damage becomes irretrievable; the patient generally dies of septic peritonitis, for which there is no adequate corrective. On the other hand, if extra-peritoneal regions manifest less tolerance of slipshod methods, the consequences of surgical shortcomings are here often retrievable by corrective measures of one or another kind. The tolerance of the peritoneum was only too often the mantle of charity under which were hidden from view sins of omission and of commission of laparotomists without surgical training. In laparotomy more than anywhere else the most rigid asepsis is a conscientious duty.

Intimately connected with the change of views respecting preparatory asepticism and irrigation is the shifting of our standpoint regarding the application of *drainage*. Imperfect cleanliness, copious irrigation, and abundant drainage represent the links of a chain forged by necessity. A faultless asepsis has often enabled us to do away both with irrigation

[1] P. Delbet: "Recherches expérimentales sur le Lavage du Péritoine." Annales de Gyn., xxxii. p. 165.

and drainage. Wounds of a moderate extent, for instance, made in herniotomy, if really aseptic, their dissection clean, and hæmostasis perfect, will behave correctly under an hermetic collodion dressing, and exactly like a subcutaneous injury. The oozing will be very moderate, scarcely penetrating the thin coat of gauze soaked in collodion, swelling none, and after the lapse of ten days we shall find the catgut stitches absorbed and the wound perfectly healed. This is a common observation of modern surgeons and does not need specific verification. The same principle finds a different application in certain operations about the joints and bones, when so-called "dead" spaces must needs be left behind. As most of these operations are done with the aid of artificial anæmia considerable oozing of blood follows the removal of Esmarch's bandage. This blood fills up the irregular cavities left by the surgeon, and, coagulating, forms there a solid aseptic plug, which is gradually consumed and replaced by connective-tissue elements of new formation. For seven years I have abandoned the use of drainage-tubes in those excisions of joints and sequestrotomies where it was possible to remove all diseased tissues in an unexceptionable manner. According to Schede's plan, I have only provided an avenue of egress for the first onrush of oozing blood by leaving one or another angle of the wound somewhat patulous. A film of protective over this little gap will prevent the absorption of the blood needed for filling up the irregular cavity of the excision wound, and will maintain sufficient moisture to prevent the exsiccation of the coagulum.

And even in operations where we are not absolutely certain of the aseptic condition of our wound we can often dispense with the use of drainage-tubes, and not incur any serious risk. Bergmann first demonstrated that a wound of doubtful asepticity can yet be made to heal by primary adhesion. He passed his suture points through the edges of the wound, but leaving them untied, and then packed the open wound and all its recesses down to the bottom with iodoform gauze. Over this was placed the usual outer dressing. Through the capillary action of the gauze copious oozing of serum was encouraged, which in about sixty hours lost its sanguinolent character, whereupon the packing being extracted the suture points left *in situ* were closed, and the wound was seen to heal in a manner little differing from primary union. Undoubtedly, much of the success of this plan of packing and secondary suture is to be attributed to the action of iodoform, which has triumphantly withstood various attacks upon its reputation.

Still another modification of this form of drainage is now extensively employed in abdominal surgery, where, on account of much unavoidable denudation or accidental infection, copious oozing is to be expected. Mikulicz was the first one to employ the iodoform-gauze packing successfully in the abdominal cavity, and his plan has met with widespread

and deserved acceptance. First, it does away with the use of the drainage-tube, and secondly, its contact with the peritoneum causes just enough adhesive irritation to insure after its removal rapid agglutination of the raw surfaces. Immediate closure of the wound can be practised after extraction of the packing. But *drainage by tubes* still remains indispensable where acute progressive suppuration has to be dealt with, as an ample way of egress must be provided for sticky and coherent masses of pus, blood-clot and sloughing tissue.

By touching this subject we have entered the realm of *antisepsis* proper. Let us now consider the comparative value of the principal measures employed for combating active, destructive suppuration, the form of infection which the surgeon has to encounter most frequently. I unhesitatingly declare, and lengthening experience tends only to confirm my conviction, that here as elsewhere, purely mechanical measures employed with a view to the removal of excessive tension and the thorough evacuation of noxious matter, such as adequate incision, properly placed drainage, the extraction of sloughs and sequestra, with frequent energetic irrigation, play a much more important part in checking mischief than chemical disinfection. Even in the treatment of destructive ulcers the constant bath and actual cautery are found to be more effective than chemical applications, though the great usefulness of the latter cannot be denied in milder processes of a superficial character.

We have seen that dry absorbent dressings, favoring rapid evaporation, are most useful in the treatment of extensive aseptic wounds, and that smaller aseptic wounds can be advantageously sealed with an hermetically occlusive collodion pad. An entirely different principle obtains in the dressing of septic or suppurating lesions, surgical or accidental.

While capillary attraction, exerted by a dry absorbent dressing, is perfectly adequate to drain an aseptic wound of its serous discharges and while the rapid drying and crusting of these dressings is just the thing we want to seal a sweet wound against the possibility of subsequent infection from without, these very qualities of the dry absorbent and occlusive dressing make it unfit for use in cases where the secretions are purulent. To begin with, pus contains so many corpuscular elements in the shape of leucocytes and shreds of decayed tissue, all suspended in a more or less viscid medium, that capillary absorption alone cannot effect much more than the removal of a portion of its serous components. The remainder, containing the more solid part of the discharges, becomes inspissated and forms a crust. Thus, artificially, retention and an aggravation of the existing mischief is brought about. A moist dressing, protected against evaporation either by remoistening or an outer covering impermeable to moisture, does not possess these disadvantages. In-

spissation being prevented, the escaping pus retains at least its original density, and is evenly absorbed and distributed through the interstices of the entire dressing. Crusting and retention will be prevented, especially if the dressings are frequently renewed. An additional and very valuable quality of the moist dressing is the soothing effect it exerts upon the inflamed parts. It soon acquires the temperature of the covered region, and the combination of warmth and moisture presents the most valuable features of the time-honored poultice without its drawbacks.

Is the impregnation by germicides of moist dressings used in cases of suppuration effective and necessary, or not? My answer is unhesitatingly negative. While the microbes contained in dense masses of pus will remain unscathed by the minute quantities of a chemical contained in our dressings, these will be very often sufficient to irritate the skin into florid eczema. Adequate incisions, efficient drainage, frequent change of dressings supplemented by irrigation, contain the essence of the successful treatment of suppuration.

In summing up we will say, finally, that though chemical sterilization is still important, and even indispensable in some fields of modern surgery, main stress belongs to those mechanical measures of purification which comprise the essential part of aseptic preparation.

Having passed in review the present status of anti-parasitic surgery we see that, although incisive changes have befallen the means employed, the principle upon which the discipline was grounded remains unshaken. The living spark of truth has survived the pedantry and over-zeal of the advocates, as well as the sneers and contempt of the opponents of the new departure. Its blessings have soothed and removed untold suffering and misery—have saved, I might say, millions of lives. For all this, humanity is indebted to one man, whose intellect pierced the deadly mists that overhung the practice of surgery. That to the activity of the surgeon, though it still remains surrounded by grave responsibilities, was added a vastly increased element of pleasure, the *gaudium certaminis* against disease and death—for this gift to his fellow-surgeons, we are indebted to Sir Joseph Lister.

THE PATHOLOGY OF OPHTHALMOPLEGIA.

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Whether we regard the complexity of the structures concerned, or the rarity of opportunity for post-mortem examination, or the indirectness and consequently secondary character of the evidence on which we accordingly have to rely, the difficulty of the explanation of the pathology of ophthalmoplegia is obvious. Bearing in mind the destination of the third, fourth and sixth nerves, with the second and parts of the fifth and seventh, together with the sympathetic, to the eye and orbital contents, the eyelids and appurtenances; the long and varied course which several of these pursue from their nuclei to their termination in the orbit; the more complicated connections of their centres with the nerve-tracts proceeding from the spinal cord, medulla, and pons, and those proceeding to the cortex of the brain, the varied and extended ocular symptoms which may result from even a small intra-cranial lesion are self-evident. Probably nowhere has post-mortem examination been of less service to pathology than here. We are constrained to rely upon clinical observations, judicious analogy, and certain experiments upon animals, for a rational explanation of the symptoms with which we are dealing. This field of research, common to the physician and the oculist, it is not surprising to find, was permitted to remain fallow until within the last twenty-five or thirty years. The term ophthalmoplegia had been employed by Brunner as early as 1850, and was first brought to the notice of Continental oculists by Von Graefe, who reported a case in 1856, and exhibited a typical example of this disease to the Berlin Medical Society on January 29, 1868. The more modern (1878) division into ophthalmoplegia externa and ophthalmoplegia interna may prove, on further investigation, to be of as little value pathologically as, according to Mauthner, it is perhaps incorrect etymologically.

The site and nature of the lesion to which the group of oculo-motor palsies (for which we employ the term ophthalmoplegia as an equivalent) is due, have been the chief points upon which discussion has taken place. It is obvious that disease affecting the nucleus of origin or the nerve in its continuity or termination, whether such disease be intrinsic or extrinsic, may be productive of results difficult to separate. Disease of the second nerve alone of all cranial nerves is recognizable by

other means than those having reference to disturbance of function. The magnified image of the optic disc exhibiting, in the case of optic neuritis, increased vascularity, lymphatic engorgement, intra-neural hemorrhage, proliferation of fibres, gives us an insight into what may be going on in other nerves during life when they are the seats of neuritis, whose evidence is only rendered visible by the less precise method of post-mortem examination, or inferred by reason of disordered function. It is now well recognized that what is called sclerosis, or some other equally precise, more acute, and more truly inflammatory process, is liable to overrun on definite lines, both centripetally and centrifugally, the cerebro-spinal system, and that the same may be scattered sparsely over the brain and cord, or localized in certain parts. It follows that the symptoms may be as diversified as the sites of this degeneration are various, and it is impossible to understand aright the effects resulting from a lesion affecting the deep origin of any one nerve, or group of nerves, without taking a survey sufficiently broad to cover similar lesions affecting neighboring areas. It was at one time argued that a group of oculo-motor paralyses occurred which was sufficiently distinct from the previously recognized single-nerve palsies or single-muscle palsies, on the one hand, and from symptoms indicating invasion of the spinal cord or brain on the other, to warrant their collection into a separate category, and their being dignified with the exclusive application of the term ophthalmoplegia. This appears to have been the view of Hutchinson when he communicated his paper on "Ophthalmoplegia Externa, or Symmetrical Immobility (partial) of the Eyes with Ptosis" to the Medico-Chirurgical Society in 1879.

He therein states that cases of single-muscle paralysis, occurring in syphilis and in locomotor ataxia, are to be distinguished from the class for which he "ventured to propose the name of ophthalmoplegia externa" upon the three following grounds:

1. By the fact of non-symmetry of the former.
2. By the early completeness of the paralysis.
3. By the ease with which very frequently they are cured.

He, however, admits that symmetry is not invariable; indeed, one of his fifteen cases was unilateral, and several others exhibited less symmetry than mere bilaterality.

As to the absence of early completeness of the symptoms, it may be true that the affection of the various muscles may be progressive, but the invasion may be sometimes sudden, as in his eighth case; and it is difficult to understand why the cause which he suggests of the unilateral and partial category of cases, viz., a gumma in the nerve-trunk, should manifest itself by suddenness of onset.

As to the comparative facility of cure in the two sets of cases, it is difficult to see why he should regard as more unfavorable those he calls

ophthalmoplegiæ, since he says: "The effects of remedies in several cases were very remarkable, the patient having been rescued from a very dangerous condition." And again: "Often it is distinctly influenced for good by treatment."

As showing that the group of palsies which Hutchinson had in view was less capable of sharp separation from the recognized results of similar affections of the neighboring parts, it is important to note that among his fifteen cases, "in six the lower extremities were more or less weak and liable to pain, the condition approaching more or less closely to locomotor ataxia," and several cases exhibited affection of other cranial nerves—*e. g.*, first, fifth, seventh, and eighth—and in two cases there was insanity; and he finally admits that "there can, however, be no doubt that ophthalmoplegia externa is sometimes a part of the general malady known as progressive locomotor ataxia."

The close similarity of these palsies to those spinal palsies common in children, and known as anterior poliomyelitis, has often been remarked, notably by Wernicke, and the term polio-encephalitis superior as opposed to polio-encephalitis inferior, or bulbar paralysis, has been suggested. This would appear to be the view entertained by Ludwig Mauthner in his valuable monograph on the subject, which reviews most of the previous literature and critically investigates the evidence at large.

We have hitherto made no mention specifically of so-called "ophthalmoplegia interna," which has been regarded in this country, in spite of accumulating evidence both physiological and pathological to the contrary, to belong to the category of orbital or peripheral lesions, rather than as of central origin. It is difficult to see *à priori* why, if a central control be allowed for the muscles of convergence, this should be denied to the muscles of accommodation, and, if allowed to the latter, why the same privilege should not of necessity be extended to the muscle of the iris.

In 1878 Hutchinson communicated to the Medico-Chirurgical Society his paper on "Paralysis of the Internal Muscles of the Eye"—ophthalmoplegia interna—a group of symptoms which probably indicates disease of the lenticular ganglion. He then held that if paralysis of the muscles of the iris and of the ciliary muscle alone coexisted the "seat of the disease can be in no other structure than the ganglion itself."

Curiously enough, out of the eight cases he relates, in five both of the eyes were affected. It will appear at the outset that such symmetry would be more easily explicable by a focal lesion in the neighborhood of the posterior part of the third ventricle where the third nerve takes its origin, than by assuming that the widely separated lenticular ganglia should be similarly and synchronously affected. How such symmetry can be comparable to the symmetry of choroiditis, as Hutchinson sug-

gests, is hard to understand. Indeed, it would appear from a footnote, which he added after the paper was read, that he was not well satisfied with the explanation he had volunteered. He says: "My only hesitation on this point is as to whether in some cases the same symptoms may be due to disease near the nucleus of the third nerve. It is not easy, however, in such cases to see why the vasomotor should be affected. I have, however, seen the pupil motionless and accommodation lost in some cases in which the disease was believed to be in this position; always, however, there were other complications."

This last observation appears to be most important and suggestive, and would seem to us to indicate at once the solidarity of so-called ophthalmoplegia interna, not only with ophthalmoplegia externa but also with bulbar and infantile spinal paralysis, so far as the nuclear nature of such lesions is concerned. Hulke, in the first volume of the *Ophthalmological Transactions* for 1880, traversed Hutchinson's lenticular ganglion theory, and suggested in its place disease of the "intra-ocular ganglionic plexuses in immediate relation with the muscular apparatus," as the approximate cause. Andamuk had demonstrated that after removal of the lenticular ganglion stimulation of the cervical sympathetic produces the usual dilatation of the pupil. This "appeared to be absolutely decisive" that there was a route from the sympathetic to the iris not *via* the lenticular ganglion. Hulke's preference for the ganglionic plexuses may be accounted for by his claim to have discovered these bodies coincidently with Müller and Schweigger in 1858.

Hutchinson, in reply to Hulke, thinks, "so far as the choice lay between a central and a peripheral seat of change, Mr. Hulke and myself are in the same boat." Gowers, who followed, suggested that they might both be in the wrong one, and taking a broader view and following the researches of Hensen and Volkers, he regarded the probable seat of the lesion as being the anterior portion of the nucleus of the third nerve.

The researches here referred to, carried out in 1878, upon dogs, went to show that the most anterior portion of the nucleus of the third nerve at the posterior part of the third ventricle was the centre for accommodation; behind this came the centre for the iris, then that for the internal rectus, and posteriorly the other muscles of the eyeball. Kohler and Picks's clinical researches powerfully support the foregoing observations, while slightly varying the arrangement of the posterior portion of the nucleus, the internal part of which they would devote to the interior and inferior recti, the outer portion comprising the nuclei for the levator palpebræ, the rectus superior, and the obliquus inferior. Both sets of observers agree in regarding the centre for the fourth nerve as practically part and parcel of that of the third, to the posterior extremity of which it is immediately adjacent. The nuclei of the sixth

appear a little further back, close to the median fissure and the olivary fillet. There is reason to believe that a path of connection between the sixth nucleus of one side and the third nucleus on the other is provided by the posterior horizontal fibres, a nexus which appears at once to explain and to be supported by the facts in regard to what is known as conjugate deviation.

It is well to note here that the recent researches of Gaskell led him to regard the lenticular ganglion as the vagrant motor ganglion of the third nerve akin to the sympathetic ganglion connected with the motor root of a spinal or segmental nerve, and composed almost entirely of third-nerve fibres. He does not regard the first division of the fifth nerve as their corresponding sensory nerve, but finds in the third and fourth trunks fibrillar tissue and cells which he considers to be the vestigial remains of long disused sensory roots and sensory (stationary) ganglia of these nerves. If this view be correct, it is doubtful whether reflex central functions can be attributed to the lenticular ganglion with any more assurance than they can be to the submaxillary ganglion. It would appear to be little more than a vestigial incident occurring in the course of distribution of the third nerve, and not to be regarded either as the primary or secondary seat of control of the intra-ocular muscles.

We have hitherto made no allusion to neural as distinguished from nuclear lesion as occasioning ocular palsy. In 1883, in *St. Bartholomew's Hospital Reports*, one of the present author's, in recording thirteen cases of oculo-motor paralysis exhibiting great variety of both unilateral and bilateral palsy, thus recorded his view of the pathology of these cases:

"In those cases where periostitis in the form of nodes or gummata was present, it is probable that the lesion was situated in the orbit or the sphenoidal fissure. In those cases of *bilateral paralysis*, especially when there is implication of the optic nerves, the base of the brain or the central ganglia are presumably the seat of disease."

In apportioning the effects of extrinsic (*e. g.*, tumor or aneurism exciting pressure), or intrinsic (*e. g.*, nucleitis or neuritis) causes it is important to bear in mind, as Mauthner insists, that we may speak of three categories of causation according to the proximity of the cause. Thus syphilis may cause tumor which may cause ophthalmoplegia. Here nerve-pressure is a cause of the first category, the cause of the proximate cause is the tumor, and the remote cause of this is syphilis. The relative irrelevance of the remote cause as compared to the proximate cause is obvious, yet its importance therapeutically is paramount.

In no other situation are there opportunities for a small lesion to affect so many cranial nerves in their continuity as in the cavernous sinus. Putting aside the rather obscure ocular palsies of cortical origin,

the floor of the aqueduct of Sylvius and fourth ventricle and the walls of the cavernous sinus would be the most favorable site for small lesions to effect large results; in the former such lesions would be mostly nuclear, in the latter necessarily neural. We would here introduce the following scheme:

OPHTHALMOPLEGIA.

I. *Cerebral.*
- (*a*) cortical
  - conjugate deviation.
  - hemi-ptosis (?).
  - hysterical ophthalmoplegia (?).
- (*b*) cortico-peduncular.
- (*c*) nuclear
  - 1. cycloplegia
  - 2. iridoplegia
  - } "ophthalmoplegia interna."
  - 3d nerve
    - 3. palsy of extra-ocular muscles.
    - ptosis.
  - 4th nerve — 4. palsy of superior oblique.
  - 6th nerve — 5. palsy of external rectus.
- (*d*) radicular (and ? commissural).

II. *Basal.*
- (*a*) region of pons (vi.).
- (*b*) " " peduncles (vi. iv. iii.).
- (*c*) " " cavernous sinus (vi. iv. iii.).
- (*d*) " " sphenoidal fissure.

III. *Orbital* (including peripheral).

Ophthalmoplegia of cortical or cortico-peduncular origin is usually conjugate, not unilateral; this is a corollary to the observation that movements, rather than muscles or nerves, are represented in the cortical colligation. The only exception to this rule apparently is that of ptosis occuring upon the opposite side exclusively to that of the cerebral lesion. (Landouzy.)

In order to complete the cerebral classification of intra-cranial sites of possible lesions resulting in ophthalmoplegia, it is necessary to add the "radicular," to include lesions intermediate between the superficial and deep origins of the various nerves concerned, and perhaps also commisural.

In addition to intra-cranial causes, there are those situate in the orbits, which logically should be made to include the so-called peripheral lesions, which some authors would place in a separate category. It is difficult to deny that in some cases of transient ptosis, symmetrical cycloparesis, convergent asthenopia may not be of peripheral neuromuscular causation; and it is certain that trauma may be productive of peripheral palsies, whether by extravasation or by more permanent sequelæ.

With a view to elucidate from a clinical standpoint some of the questions we have raised in what has preceded, we have been at some pains to collect and classify such available cases of ophthalmoplegia in English literature as would lend themselves to such treatment. We have

kept apart those cases in which paralysis of the intrinsic muscles of the eye only existed—twenty-one in number—and the heads of classification we have adopted have been the following:

1. Sex.
2. Age.
3. Alleged cause.
4. History, personal and family, with duration and cause of symptoms.
5. Seat of lesion as found, or presumed or inferred.
6. Symptoms, including the muscles paralyzed, vision, headache, condition of pupils, reflexes, optic discs, etc.
7. The treatment.
8. The result.
9. The autopsy in the rare instances in which such has been made.

Sex. Of 120 cases of ophthalmoplegia 73 were males, 39 females, 8 unstated, giving 65 per cent. of the stated cases as males, showing a considerable preponderance in the male sex.

Age. Of the 120 cases, in 111 the age was stated. From 0 there were 8 cases; from 10 there were 17; from 20 there were 26; from 30 there were 28; from 40 there were 19; from 50 there were 6; from 60 there were 4; from 70 there were 3; from 80 and upward there were 0; with 9 not stated = 120.

This summary, in the absence of the number of the population living at each decade, of course tells us nothing as to the actual age-incidence of the disease; but, inasmuch as the population living at each ten years' period is less than that at any previous ten-year period, it proves that the increasing number of cases up to between 30 and 40 indicates a greatly increased liability to the disease up to that age. The fall to 19 in the next period—40 to 50, if viewed in relation to population living at such age—would not show any such considerably reduced liability to attack at that age as probably does occur at the ages beyond fifty.

Syphilis as a cause. In 40 cases out of the 120 there was some evidence or other of syphilis apart from the ophthalmoplegia, or in 33 per cent. of the whole. Of the 40 the result in 32 was stated. In 23 there was improvement under treatment, 11 recovered, and in 9 others the improvement was stated to be considerable and substantial; in 7 there was no improvement, 1 was said to be progressive, and 1 was known to terminate fatally. On these facts we would remark that, while quite agreeing with Mr. Hutchinson that a more careful search for evidence of syphilis might most probably have revealed its presence in a larger number of cases, the disease, even in its central form, is probably not exclusively syphilitic; but if syphilitic, and if unaccompanied by other more serious central disease, and especially if treated early, is apt to be very amenable to remedies.

Eye affected. Of 109 cases, 1 eye only was affected in 61 cases, both eyes in 48. In the 61 cases in which only one eye was affected, this was the right in 31, the left in 30; showing that the side affected is a matter of indifference. The above figures, of course, destroy the importance attached to the symmetry of the lesion. Our cases include many in which the affection was in the nerve-trunks, but in some of these the palsy was bilateral; and we think far too great importance has been attached to the question of symmetry as deciding the seat of the lesion.

Distribution of the palsy as regards various portions of third nerve. Of the 120 cases of ophthalmoplegia in which the external ocular muscles were affected, there was evidence of some affection of intra-ocular muscles in 65.

In 29 of the 65 both iris and ciliary muscle were involved.

We would, however, direct especial attention to the mode of linking of extra-ocular palsy with cycloplegia and indoplegia respectively as bearing upon the work of Hensen and Volker and of Kohler and Pick.

In the 34 cases in which only one of the two (viz., iris or ciliary) was affected, plus extra-ocular palsy, in no less than 31 it was the iris and not the ciliary, and in only 3 was it the ciliary and not the iris. If it be true that the centres for ciliary, iris, and extra-ocular muscles are arranged in that order—tandem fashion—on the floor of the aqueduct, we can understand why the linking of the palsies should be as above.

Distribution of palsy as regards nerves involved. Of the 116 cases in which the analysis could be made, in 47 the third nerve alone was affected (in 18 complete, in 29 incomplete); in 42 the third, fourth, and sixth were affected in company; in 11 the sixth alone was affected; in 8 the third and fourth failed together; in 4 the third and sixth are presumed to have been associated in palsy; in 2 the fourth and sixth, and in 2 the fourth alone.

The frequent bracketing of the third, fourth, and sixth might suggest the frequency of lesion in the course of the nerve-trunks; but the relative infrequency of attack of the sixth, in spite of its longer and more arduous extra-cerebral, intra-cranial course, would rather suggest an opposite reflection. The direct connections between the sixth nuclei and those of the third and fourth by the posterior horizontal fibres are to be borne in mind.

Result. Of the 92 cases out of the 120 in which the result is noted 53 improved under treatment, 26 completely recovering, and in 14 more the improvement was stated to be considerable; in 15 there was no improvement, in 2 the disease was progressive, and in 22 it was fatal.

Age and fatality. We have previously suggested that ophthalmoplegia of young children was probably more serious and fatal than that of adults. Of 6 cases under ten in which the result is recorded, 3 died, or 50 per cent.; of the 86 over ten in which the result is recorded, 19 died, or 23 per cent.

REVIEWS.

DIE PEPTONE IN IHRER WISSENSCHAFTLICHEN UND PRAKTISCHEN BEDEUTUNG: STUDIEN ZUR LEHRE VON DER VERDAUUNG DER EIWEISSKÖRPER UND DES LEIMES. Von DR. V. GERLACH. Hamburg und Leipzig: Leopold Voss, 1891.

THE PEPTONES: THEIR SCIENTIFIC AND PRACTICAL SIGNIFICANCE. STUDIES TOWARD THE KNOWLEDGE OF THE DIGESTION OF THE PROTEID BODIES AND GELATIN.

THIS interesting publication of a series of original investigations, made partly at the physiological laboratory of Professor Kühne in Heidelberg and continued at the hygienic department of the laboratory of Dr. Schmitt in Wiesbaden, begins with a historical review of the development of our knowledge of digestion and nutrition, and then dwells on the present views on this subject. The splitting up of the albumin molecule into the anti- and hemi-groups of Kühne and Chittenden, and especially the formation of the albumoses, are freely commented on. The amounts of nitrogen and anti-albumin and anti-peptone, also hemi-albumose and hemi-peptone, as found by Kühne and Chittenden, were gone over by the author, and pure albumoses and pure peptone produced by him. With these latter he made further studies on their nutritive value on animals by controlling the nitrogen ingested and that eliminated. In this manner he proves that the albumoses are quite able to take the place of meat as proteid food; further, that they are well borne by the animals and readily taken by them. With the pure peptones he could not determine any results, as they invariably disagreed with the experimental animals. He also prepared gelatin absolutely free from albumin, and from it gelatin-peptone. He determined the amount of nitrogen in this also, and made a series of nutrition experiments with it, both alone and together with meat. He found here that with gelatin-peptone alone there was a steady loss of body nitrogen, so that it does not possess nutritive qualities sufficient to take the place of meat; but when fed with meat together, it increased the body nitrogen over the simple meat diet. Thus he claims to prove that, though no substitute for meat by itself, it brings about a saving of the latter when fed with it.

The practical application of the author's investigations is in connection with the estimation of the food value of the so-called "meat peptones." He arrives at the conclusion that, as they are principally composed of albumoses and of gelatin- (chondrin-) peptones, they are valuable substitutes for albuminous diet, quite able to take their place, and by comparison and comparative experiments with a number of them, claims the greatest food value for the "Kemmerich's meat peptones."

L. W.

TEXT-BOOK OF MEDICAL JURISPRUDENCE AND TOXICOLOGY. By JOHN J. REESE, M.D., etc. Third (revised and enlarged) edition. Philadelphia: P. Blakiston, Son & Co., 1891.

THE third edition of this well-known work needs scarcely any comment at our hands. It has been so fully and favorably dwelt upon in THE JOURNAL at its former appearances that but little more can be added now. That it is a standard work of American medical literature is not saying too much for it, also that it is a thoroughly reliable guide for the practitioner if called upon to define his position in the judicial forum.

To the student of medical jurisprudence and toxicology it is invaluable, as it is concise, clear, and thorough in every respect. The absence of cumbersome quotations enhances its value.

If any fault were to be found with it, it would be of quantity, rather than quality. Thus, with somnabulism and other conditions of irresponsibility, the question of hypnotism might have been considered in this edition.

The additions especially valuable in the present revision are the chapter on the Ptomaines and Formad's investigation and technique for the restoration and measurement of blood-corpuscles. L. W.

THE MODERN ANTIPYRETICS: THEIR ACTION IN HEALTH AND DISEASE. By ISAAC OTT, M.D., Ex-Fellow in Biology, Johns Hopkins University; Ex-President of the American Neurological Association; Consulting Physician to the Easton Hospital; Corresponding Member of the German Medical Society of New York, etc. Pp. 52. Easton: E. D. Vogel, 1891.

IN this little volume a preliminary chapter is devoted to an account of original work on the nature of fever. The author's position is that fever, though primarily set up by an increase in heat-production beyond that of heat-dissipation, continues not from excessive production, but from an altered relation between production and dissipation. This is corroborated by experiments on the dog, and by the use of a calorimeter made large enough to hold a man. A detailed record, among others, is given of the study of a malarial paroxysm made with this apparatus, which is described and illustrated. The amount of heat produced by muscular exercise was also investigated.

After a short reference to the chemistry of antipyretics, their general action in health and disease is considered. The conclusion is reached that in fever antipyresis is usually set up by a temporary decrease of heat-production beyond that of dissipation.

Under the head of therapeutics, these drugs are discussed separately as to their physiological action, toxicology, and clinical use. In a few pages much information is condensed which has not been readily accessible.

The value of antipyretics in typhoid fever receives consideration in a

separate chapter. The author assigns them a secondary position in the treatment of this disease, particularly because of their depressant heart action. He prefers quinine for occasional use in grave hyperpyrexia, unless there is great cerebral excitation, when antipyrine does better. A description of Brand's method of cold-water treatment is appended.

G. E. S.

LECTURES ON DIABETES; INCLUDING THE BRADSHAW LECTURE, DELIVERED BEFORE THE ROYAL COLLEGE OF PHYSICIANS, AUGUST 18, 1890. By ROBERT SAUNDBY, M.D., F.R.C.P., Lond., etc. 12mo. pp. 232. New York: E. B. West & Co., 1891.

THERE can scarcely be a more difficult part in the rôle of medical authorship at the present day than to write a satisfactory book on diabetes. It is a disease that has long been known; an enormous number of clinical facts has therefore been accumulated bearing upon it, while no department of physiology has had added to it so much accurate experimental knowledge as the glycogenic function of the liver; yet we know neither the cause nor pathology of diabetes. As much as is known has been known a long time, and whenever a new book is announced the reader naturally expects more than he receives.

Each carefully collated volume, however, adds to the stock of knowledge whence we must some day extract the kernel of a solution of the vexed problem. Dr. Saundby's book is no exception. The direction in which he has efficiently aided us is in the geographical distribution of the disease and in its morbid anatomy. In the former respect his work is complemental to the equally excellent book of Dr. Purdy, of this country. Dr. Saundby's book is especially complete in this direction so far as Europe and Asia are concerned, while it is signally deficient in the American distribution. On the other hand, Dr. Purdy's account of the distribution of the disease in America is by far the most complete and exhaustive yet published, and he who follows will have the advantage of their joint labors. The most important result of Dr. Purdy's observations is, that the disease is peculiarly prevalent in our northwest and northeast, and hence the conclusion that cold and dampness are important factors in production; and Dr. Saundby's, that the disease is very common among the educated and learned class in India—chiefly non-flesh-eaters. Dr. Saundby has collected many individual cases bearing upon the etiology, but it cannot be said that they add much to what was previously known.

The second feature of Dr. Saundby's book by which it is to be distinguished from others is the exhaustive treatment of the morbid anatomy, no surprise to any one who had the privilege of hearing Dr. Saundby's Bradshaw Lectures, as happened to the writer. The most hopeful organ in this direction at the present day is the pancreas, since not only are there constantly being added to the original cases of Lanceraux others wherein the autopsy after diabetes has disclosed pancreatic disease, but there are now also to be added cases of diabetes consequent on extirpation of the pancreas, not only in animals but also in man. The presence of well-defined cases, however, in which there has been no pan-

creatic lesion, and of others where the disease followed blows on the stomach or other localities where the semilunar ganglion could be reached, goes to show that it is likely to be the sympathetic system of nerves which is really responsible even in pancreatic cases.

One turns naturally in every new book to the treatment of such an intractable disease as diabetes. It cannot be said that Dr. Saundby helps us greatly, but at the same time the old treatment is well reviewed and the chaff thoroughly sifted from the grain—and it must be said there is a good deal more of the former than the latter. The dietetic treatment remains the best, while opium is the only adjuvant in the shape of a drug which can be relied upon.

Dr. Saundby's book is welcome to our shelves as reflecting the most recent information on the subject, and as a safe guide to the practitioner for the management of any cases which may come under his care.

J. T.

PRACTICAL PATHOLOGY AND MORBID HISTOLOGY. By HENEAGE GIBBES, Professor of Pathology in the University of Michigan, etc. Illustrated with Sixty Photographic Reproductions. 8vo., pp. xvi., 320. Philadelphia: Lea Brothers & Co., 1891.

THE book is divided into four sections: Part I., Practical Pathology; Part II., Practical Bacteriology; Part III., Morbid Histology; Part IV., Photography with the Microscope. The subjects included under the different sections are as well treated as could be the case in the limits allowed. We are unable to agree, however, that "such instructions are given as will enable him (the student) to transfer a specimen of any morbid change directly to his microscope in an unaltered condition, and to recognize it unerringly." Such a result can only be obtained with a much more exhaustive volume than the one here spoken of. It is an omission to have made no mention of the Koch-Ehrlich method of staining the bacillus of tuberculosis—for this method is one that every student should at least be familiar with.

Taken as a whole, the volume will very well carry out its purpose—that of an aid to the student—and the typography and its illustrations are extremely good.

H. C. E.

BACTERIA AND THEIR PRODUCTS. By GERMAN SIMS WOODHEAD, M.D. Edin., Director of the Laboratories of the Conjoint Board of the Royal College of Physicians (Lond.) and Surgeons (Eng.), etc. With 20 photomicrographs, and an appendix giving a short account of bacteriological methods, and a diagnostic description of the commoner bacteria. 8vo., pp. xiii., 454. London: Walter Scott, 1891.

THIS book is, in the language of the preface, "an attempt to give some account of the main facts in bacteriology, and of the life-history of the bacteria and closely allied organisms, and also to discuss the more im-

portant theories as to the part played by them in Nature's economy; especially in their relation to the commoner fermentative, putrefactive and diseased processes." The result of the author's efforts is a more full work of the sort than any with which we are yet familiar in the English language. The arrangement is very similar to that of Löffler's *Vorlesungen*, and at the end of each section there is placed a series of references to the more important works upon the subject just treated. To one interested in the development of bacteriology, and in its present condition, this book will be of value as containing a fairly extensive epitome of what is known, and especially for the facilities given for further reading upon the subject. H. C. E.

THE LATIN GRAMMAR OF PHARMACY AND MEDICINE. By D. H. ROBINSON, Ph.D., Professor of Latin Language and Literature, University of Kansas. With an Introduction by L. E. SAYRE, Ph.G., Professor of Pharmacy in, and Dean of, Department of Pharmacy, University of Kansas. Pp. 271. Philadelphia: P. Blakiston & Co., 1890.

A CURIOUS outgrowth of the modern tendency to narrow specialism in education is this volume, which is designed for the use of those whose limitations compel a short preparation only for the practice of medicine or pharmacy. Somewhat in the form of a beginner's Latin book, it aims to use words and examples in teaching which will serve to familiarize the student from the start with medical and pharmaceutical terms.

It must be confessed that it is startling at first to find, instead of the traditional and familiar sentences about Balbus or Romulus or the she-wolf, such exercises for translation as these: "Is the syrup of ipecac a good remedy for a bad boy?" "What is on our friend's nose? A capsicum plaster." "Nitric acid bit the boy's third finger." Truly, this is a utilitarian age. While it must be admitted that under ordinary methods a considerable vocabulary is acquired which cannot be directly applied in pharmacy or medicine, there may be an error in the other direction. Large numbers of technical words, as names of drugs, are transferred almost bodily into English. There is little advantage in being familiar with them as words simply, when their meaning is unknown to the beginner, while the use of unwieldy terms would seem to make more embarrassing than ever the Latin construction. After all, a vocabulary can best be acquired by associating a word with an object or its use.

There is much in the exercises here given which can only be of use to students of pharmacy, and it is probable that among these the work will find its chief field. For instance, one of the exercises to be translated into Latin consists of the formula and the method of preparing the compound fluid extract of sarsaparilla. It is doubtful whether there is any practical improvement upon a narrative of the Romulus and Remus type in the translation of the following: "Moisten the powders with twenty ounces of this mixture, and pack it firmly in a cylindrical percolator."

Granted that his whole knowledge is superficial, the question arises

whether a man is more likely to write correct prescriptions after learning the declension of *adeps* rather than that of the time-honored *rex*.

The book, which stands alone in its field, is written by a teacher who has been obliged to confront the difficulties caused by poor preparation among students. The general plan is undoubtedly the outgrowth of his experience, and as such deserves respectful consideration. While the method utterly divorces the language from its literature and cuts off the comparative study of other languages, it is conceivable that it should help the short-term student to a working knowledge. Though in the individual case it may serve a purpose, its adoption in a school could not fail to maintain a low standard.

It seems a mistake to advise the so-called Roman method of pronunciation. If ever the English method is justifiable it is here, since all scientific terms are Anglicized. Why, for instance, teach a student of pharmacy to pronounce *gentiana* with "*g*" as in "*give*," or *cinnamomum* with "*c*" as in "*cave*." "*Yalapa*" for *jalapa* strikes one as odd, even in this book of incongruities.

A useful feature is the frequent giving of simple derivations of compound words, including many of Greek origin. The word ὑδωρ, water, looks unnatural when spelled "hudor," but the end of simplicity is attained. G. E. S.

A MANUAL OF DISEASES OF THE NOSE AND THROAT, INCLUDING THE NOSE, NASO-PHARYNX, PHARYNX AND LARYNX. By PROCTOR S. HUTCHINSON, M.R.C.S., Assistant Surgeon to the Hospital for Diseases of the Throat. With Illustrations. 12mo. pp. x., 127. London: H. K. Lewis, 1891.

A FAIRLY good primer with a good index. Upon 124 pages no less than 64 subjects noted in the table of contents are summarized, with 38 illustrations, and some of them large ones. Ten pages concerning paralyses of the larynx are by far the best of the batch. The illustrations are excellent. A novel departure is presented in sandwiching the subject-matter between three terminal pages devoted to diseases of the larynx in the lower animals, and two full-page initial display plates illustrating morbid growths of the larynx and trachea in dogs, and atrophied muscles of the larynx of a "roaring" horse. J. S. C.

ATLAS OF CLINICAL MEDICINE. By BYROM BRAMWELL, M.D., F.R.C.P. Edin.; F.R.S. Edin.; Assistant Physician to the Edinburgh Royal Infirmary, etc. Volume I., Part I. Edinburgh: T. & A. Constable, 1891.

THE contents of the first instalment of this work, which will probably soon be widely known as *Bramwell's Atlas*, are: Myxœdema; Clinical Investigation of Cases of Myxœdema; Sporadic Cretinism; The Clinical Investigation of Cases of Sporadic Cretinism; Myxœdema and Exophthalmic Goitre Contrasted; Friedreich's Ataxia; The Clinical Investi-

gation of Friedreich's Ataxia; Notes of Three Additional Cases of Friedreich's Ataxia.

It must not be supposed that the work is, as its name implies, a mere collection of pictorial illustrations of disease. The plates are certainly its most striking feature, both on account of the excellence of their execution and their truth to nature, but they are, after all, but the complements of a verbal description, in every instance admirable, of the subjects they represent. Without the plates the work would take rank as a standard on the subjects of which it treats; with them, it does away with those false conceptions which are sure to arise in the mind of the mere textualist. We cannot recommend this Atlas too strongly, especially to teachers and to those who are deprived by absence from great medical centres of many clinical advantages; but in mentioning these two classes of physicians we do not exclude anyone who has it in his power to obtain the work.

F. P. H.

TEXT-BOOK OF HYGIENE. By GEORGE H. ROHÉ, M.D., Professor of Obstetrics in the College of Physicians and Surgeons, Baltimore, etc. 8vo. Second edition, revised and rewritten. Philadelphia: F. A. Davis, 1890.

A BOOK whose purpose is to teach men how to live long is always welcome. In these days of wonderfully rapid development of the science of hygiene, when only those skilled in bacteriological research can keep pace with its march, it becomes an urgent need to have a book in which the practical results of so much progress are stated in a clear and concise form, intelligible to the ordinary practitioner and student, as well as to the laity. This purpose is certainly filled by the present work. "The author cannot flatter himself that much in the volume is new. He hopes nothing in it is untrue." With this apology, he certainly deserves credit for the clear-cut manner in which he handles the important sanitary problems. In twenty-two chapters the various departments of hygiene are treated in a manner that embodies in practical application all that the later development of bacteriology has taught us. Especially commendable are the chapters giving a concise but pointed description of contagion, infection, and the use of antiseptics, deodorants, and disinfectants. Prophylaxis, *in place*, has been given due importance, and the accurate and comprehensive description of the Quarantine Station, as established and conducted by the Louisiana State Board of Health, is a valuable addition to the merits of the work, giving the student and practitioner the application on a gigantic scale of the principles which he is called upon to use in daily practice, should he wish to be abreast of the times in the fight against infection and contagion. On the whole, we believe that the author's purpose has been fully achieved, and that this volume, though not an exhaustive treatise, is called to furnish much valuable knowledge in a most accessible form.

E. L.

PROGRESS

OF

MEDICAL SCIENCE.

THERAPEUTICS.

UNDER THE CHARGE OF

REYNOLD W. WILCOX, A.M., M.D.,
PROFESSOR OF CLINICAL MEDICINE IN THE NEW YORK POST-GRADUATE MEDICAL SCHOOL;
ASSISTANT VISITING PHYSICIAN TO BELLEVUE HOSPITAL.

Salicylate of Sodium in the Treatment of Diabetes.

The treatment of diabetes mellitus by salicylate of sodium is by no means novel. Speaking generally, there are two great classes of diabetics. In the first are those on whom the disease falls while they are quite young, with symptoms of great intensity; as a rule, to which at present there are very few exceptions, this form is quickly fatal. The second class includes those who are attacked when they are elderly and of gouty tendencies. In these it may not be very active; they may even become fat while they are suffering from it; they have not much glycosuria or polyuria, and they often do not die from the diabetes itself.

Dr. Mansel Sympson reports a case where the salicylic treatment was successful in the more fatal class of cases, that is in the younger and more fatal form. The patient was an engineer's apprentice, seventeen years old, who came under Dr. Sympson's care on April 18, 1891. The family history was not good; he had been a fairly healthy lad until about six weeks before. The urine was very pale, greenish-yellow in tint, limpid, also smelling of apples, very acid, of a specific gravity of 1040, free from albumin, but giving a great deal of sugar. He was passing about seven pints in the twenty-four hours. He was at once put on a mixture of ten grains of salicylate of sodium, five drops of tincture of nux vomica, and an ounce of infusion of gentian, to be taken every four hours. He was also cut off absolutely from sugar, pastry, bread (save well-baked toast), and biscuits, and of course from potatoes and starchy vegetables.

In the first week his water became gradually reduced in quantity, from seven to five and a quarter pints in the twenty-four hours, while its specific gravity varied from 1050 to 1040, the amount of sugar remaining about the

same, or decreasing a very little. His medicine was only given *sextis horis* at the end of the first week. He suffered a good deal with headache, which was relieved by the salicylate and by citrate of caffeine. By the middle of the second week he was on strict diet, gluten bread, almond cakes, etc., with no starch or sugar in any form. His urine was greatly improved, only three pints being passed in the twenty-four hours, of specific gravity 1024, and containing by Dr. Oliver's test a little over five grains to the ounce. His thirst was lessening, headache had vanished, and his sense of satisfaction with both meat and drink was increasing. About the twelfth day of treatment he was passing about two pints of urine, of specific gravity 1014, with a mere trace of sugar. In six more days there was no sugar at all in his water. On April 10th, having been without medicine for four days, passed about half a pint more water daily, and had suffered from a slight return of the headache. On May 18th had been again off the salicylate mixture for three days, with the result that he passed just twice as much water daily as he had done before. He complained also a little of pains in his back when without the medicine. Since May 19th his water had never been over two and three-quarters pints; it had never contained any trace of sugar; and on June 24th it was acid, specific gravity 1025, no albumin or sugar.

When the patient was on a mixed diet at the very beginning of treatment, salicylate of sodium made a difference of nearly two pints per diem in the amount of water passed; again, when he was on strict diet, the temporary cessation of the medicine on two occasions caused him each time to pass nearly double as much water as he did before or since, and gave him much uneasiness and more desire to micturate.

It may be due to the salicylate that the urine became free from sugar and kept so; it is, however, to be borne in mind that the effect of diet in some cases is marvellous, and the case cannot be considered as cured until the patient has been without the medicine again for some considerable time, and has had a mixed diet without showing evidence of glycosuria.

The action of salicylate of sodium in this case is well worth recording; the more of such cases which are known the more encouraging this method of treatment will be.—*Practitioner*, No. 278, 1891.

The Treatment of Epilepsy by the Combined Use of Bromides and some Agent Capable of Producing Anæmia of the Nervous Centres.

Poulet's conclusions, as given in the *Bulletin général de Thérapeutique*, are as follows:

The bromides constitute the basis of the treatment of epilepsy. Among them the bromide of gold does not possess the advantages ascribed to it by some, and must yield the palm to the bromide of potassium. There are always a number of cases of epilepsy which though benefited by bromide treatment are not as efficiently treated as they admit of being.

In such cases the addition of one of the following drugs—Calabar bean, picrotaine, belladonna, and, in cardiac epilepsy, digitalis—will frequently bring about the desired result, viz., the suppression of the attacks. This will

hold in general for epilepsy, pure and simple, as well as for many cases of Jacksonian epilepsy, though in this latter disease the search for the exciting cause, and its removal where possible, must always precede the above palliative treatment. In cardiac epilepsy twenty-four to thirty drops of the tincture of digitalis, or about four grains of the powder may be given along with the bromides.

Antipyrine in the Treatment of Pleural Effusions.

Clement, in the *Lyon Médical*, commends the value of antipyrine in the treatment of acute and chronic pleural effusions. The drug to be effective must be given in doses of about fifteen grains every four hours, and continued in somewhat smaller doses for several days after the disappearance of the effusion, a result which he states may be expected in from one to four days. Purulent or bloody effusions are not favorably affected, and when the pleural cavity is completely filled, Clement prefers immediate resort to paracentesis. He is at a loss to explain this singular effect of the drug upon any other ground than its specific action upon inflammatory processes, the kidneys or skin never having shown sufficient over-activity to account for the rapid subsidence of the effusion.

Death under Methylene.

Dr. Edward Chamberlayne recently administered methylene for an operation for the removal of a cancer of the breast. It was slowly given in a Junker's inhaler, and the inhaler was removed from time to time. Besides the supply of air through the valves of the inhaler, there was a space, owing to the falling in of the cheeks, easily admitting the tips of two fingers, on each side of the mouth between the mouth and the inhaler. All went well until about twenty minutes after the administration was begun, when the patient began to heave as if to vomit. The apparatus was at once removed; the heaving lasted a minute and a half, after which she made several deep inspirations of air. A moment later respiration suddenly ceased. Artificial respiration was instantly begun, and kept up for an hour and twenty minutes; it was then decided that the case was hopeless. Six injections of ether and three enemata of brandy had previously been used. About three drachms of methylene were used. There was no post-mortem; her heart had been frequently examined by her medical attendant, and was believed to be healthy. —*Lancet*, 1891, No. 3548.

A New Antiseptic.

No sooner is one antiseptic chemical rejected by some disappointed disciple of antisepticism, than he is greeted by a new chemical possessing all the virtues and free from all the vices of its predecessor. Dr. Berlioz now presents to the Parisian Academy of Medicine a new chemical which already has proved itself worthy, if we accept the statements of its advocates, of general recognition as the best of antiseptics. He names it "Microcidine" —a name to which it is hardly entitled, seeing that its germicidal powers are inferior to those of corrosive sublimate.

According to Professor Polaillon, the new drug is not a definite chemical

compound, but rather a mixture of β-naphthol and hydroxylate of sodium. This new product is soluble in three times its weight of cold water, the solution being of a brown color, which disappears on dilution. The chief advantages claimed for this, the latest of antiseptics, was its slight cost and its non-poisonousness. As it is eliminated by the kidneys, it should be found useful in cases of chronic cystitis with fetid urine. The value of the naphthols α and β in the tympany of typhoid is well known, and as microcidine is simply a product of the fusion of β-naphthol with the hydroxylate of sodium, it should prove useful in such cases.—*Medical Press*, September 16, 1891.

The Toxic Dose of Oil of Turpentine.

The daughter of a former Hawaiian missionary states that the natives are so fond of drink that the native house-painters will drink oil of turpentine for its intoxicating effect when they are unable to obtain any other stimulant. They have been known to drink as much as a pint at a time. From this statement it would appear that the toxic dose of this substance is far beyond any dose dreamed of by therapeutists.—*New York Medical Journal*, 1891, No. 25.

A New Mode of Administering the Bromides.

In Paris the pharmacists have been astonished by the increasing number of prescriptions wherein the bromides are combined with naphthol and bismuth. This is simply carrying out suggestions made by Professor Féré, that large doses of the bromides tended, in certain individuals, to beget unpleasant symptoms, chiefly for the reason that the gastro-intestinal tract of such persons was in a condition of sepsis that prevented the proper assimilation of the drugs. He recommended the administration of such intestinal antiseptics as naphthol and salicylate of bismuth as a means of removing drug intolerance from this and from other causes. The following formula is one method found by him to be advantageous, in the treatment of epileptics especially:

℞.—Bromide of potassium . . . . . ℥iss.
β-naphthol . . . . . ℥j.
Salicylate of sodium . . . . . ℥ss.

Mix, and divide into three doses, one dose to be given three times daily.

It is maintained by Féré that this treatment is curative as well as preventive. He has found that the eczema and psoriasis which sometimes follow in the train of borax will also disappear if the intestinal tract is rendered aseptic.

Peroxide of Hydrogen in Diseases of the Eye.

The following is a summary of the conclusions of Dr. S. S. Golovin regarding the use of peroxide of hydrogen in ophthalmic practice:

In healthy eyes the peroxide causes only trifling smarting and transient congestion of the conjunctiva. In diseased eyes, especially when deep corneal ulcers are present, instillation of the peroxide may give rise to a more or less intense burning sensation, which, however, quickly disappears spontaneously.

A reliable preparation should always be employed. The peroxide solutions are somewhat unstable, but decomposition can easily be prevented by the addition of a small quantity of sulphuric ether, and by keeping the mixture in an opaque glass in a dark place. A 3 per cent. solution may be employed for lotions or irrigations; stronger solutions should be used in the form of eye-drops.

℞.—Hydrogenii hyperoxydati (10 to 15 per cent.) . ℥iss.
Ætheris sulphurici . . . . . gtt. j.
(Keep in a bottle of dark glass.)

Sig.—A few drops to be instilled into the eye several times a day.

The best results are obtained in corneal affections. Simple ulcers of the membrane rapidly disappear without being complicated with purulent infiltrations. Suppurating ulcers speedily assume a cleaner and healthier appearance, infiltrations undergo absorption, the lesions healing without perforation of the cornea occurring. Even in severe cases the only traces remaining at the site of the ulcers are slight opacities corresponding to the deepest portion of the excavation. The peroxide is also invaluable in cases of hypopyon keratitis. Provided the instillations are made regularly and thoroughly, even cases in which otherwise operative interference would be necessary, yield to the remedy.

Of conjunctival affections, the peroxide is especially of service in cases of phlyctenular conjunctivitis, which is cured by it much more rapidly than by ordinary treatment. It is also useful in the early stages of acute gonorrhœal ophthalmia (in which the instillation should be repeated not less than four or five times daily, or even every two hours), though the effects scarcely go beyond sterilizing the discharge and preventing or controlling corneal lesions. In simple acute and chronic diffuse catarrhs of the conjunctiva, as well as in trachomatous or follicular conjunctivitis, the peroxide seems to be useless.

[Much of the peroxide sold in this country is acid in reaction, and would be unsuitable to be dropped into the eye unless neutralized, in which case it keeps less well than when its reaction is acid.—Ed.]—*British Medical Journal*, 1891, No. 1599.

The Methodical Employment of Sulphonal in Mental Diseases.

Dr. Forster publishes his experience with fifty-six patients of the Königsmutter Institution. He was much pleased with the result. The drug acted principally as a motor depressant. Noisy, obstreperous patients were quieted down; many who were given to soiling themselves, ceased to do so. This condition of restfulness was induced in excitement stages of acute and chronic insanity, periodical and chronic mania, senile dementia, progressive paralysis, idiocy, and epilepsy. Thirty grains were generally sufficient, but as much as sixty were sometimes given. The single dose was from seven and a half to fifteen grains. In periodical excitement, given continuously, it shortened and ameliorated the period of excitement. It was of special value in acute melancholia and insanity. Epileptic attacks were not so violent; a cure of the epilepsy was not achieved.

He observed two forms of disagreeable by-effects, called by him sulphonal-

ismus. The first was a motor and sensory depressive form, that appeared as paretic weakness, at first of the lower extremities, then of the tongue and upper extremities. The other form was a persistent somnolency, and a diminution of sensation, weakening, or extinction of the cutaneous sensibility. The first stage of this was not dangerous, but the second required careful observation. The symptoms disappeared quickly on reduction of the dose of sulphonal. The pulse was generally regular and powerful. Neither respiration nor the uro-genital system was injuriously affected. Disturbances of the digestive tract were, however, observed twice, with an exanthem. Tolerance of the drug was never observed, so that, unlike morphine, it can be discontinued at any time.—*Medical Press*, 1891, No. 2730.

Oxygen as a Distinct Remedy for Disease, and a Life-saving Agent in Extreme Cases.

On this subject, Dr. A. W. Catlin contributes an article, and cites cases where oxygen has been used with advantage. Primarily, and for a long time exclusively, this agent has been recommended in lung difficulties—more especially to relieve the dyspnœa and cyanotic conditions following in the train of a pneumonia, where a large amount of lung-structure is involved: another way of stating the fact that its use was deferrred until the disease was far advanced, the strength exhausted, and the recuperative powers in abeyance—in other words, a *dernier ressort*, as a palliative, but not as a curative.

Fortunately, however, for our patients, another view is now taken of this life-saving agent, and to-day we recognize the fact that if we can, with a limited lung-capacity in acute disease, pass more or less continuously the same quantum of oxygen into the blood that is normally required when no disease is present, we practically lift our patient to the plane of health, so far as functional activity is concerned, and give him a hundred-fold more strength to battle with than before.

Dr. Catlin desires to show that oxygen is the most sure and satisfactory stimulant we have; that by being exhibited through the lungs, and not by the stomach, its entrance into the circulation is much more certain and immediate; that its effect, felt primarily upon the heart, is almost as quickly seen at the nerve centres and in the digestive organs; that it is preëminently the remedy for profound shock, either from hemorrhage or nervous drain, where vitality is at too low an ebb to take up the intricate history of assimilation and repair.

To get the best results the remedy must be administered at first freely and continuously, especially in those cases of profound shock where the depleted centres of life must have this true stimulation offered unremittingly. The only indications for a suspension of its use is a condition at once recognized by the patient, viz., super-exhilaration and dizziness, and this limitation is rarely reached in these extreme cases where the inhalations are not as deep or prolonged as they are when the strength returns and the demand for the stimulant naturally begins to limit itself. In other words, the patient, once instructed in its use and conscious of its helpfulness, is the best guide in its administration, and can be safely allowed to breathe it *ad libitum*. The fear

is they will not get enough, not that they will get too much. This, of course, implies that the pure gas mixed with nitrogen, two parts of the former to one of the latter, is being used.

There are many conditions under which oxygen can be exhibited, always with relief, even if the nature of the case is necessarily fatal. It is no small thing to say that it relieves needless suffering.

The objection so often raised to it as a cumbersome remedy, not easily obtained on short notice, no longer holds, for depots are established all over our large cities.—*Medical Record*, 1891, No. 1086.

Diuretin.

Von Schröder found that both caffeine and theobromine had a marked diuretic action, and that caffeine had also an undesirable influence upon the brain and vasomotor centres. The fact that theobromine acted only upon the kidneys induced Chr. Gram (*Therapeutische Monatshefte*, 1890, No. 1) to make clinical trials of its diuretic action. It was, however, soon found to have disadvantages; since it is only slightly soluble, it sometimes caused vomiting. After many attempts, Gram succeeded in finding a compound of theobromine which had not these disadvantages; this was a combination of a sodium salt of theobromine with salicylate of sodium, to which was given the name diuretin. This substance is soluble in water. The dose is fifteen grains, and this amount may be given six times a day. The diuresis after two or three days is marked, and it continues for a time after the withdrawal of the drug. If albumin is present, its amount is unchanged by the drug.

It will act as a diuretic in some cases where digitalis, caffeine, and strophanthus have failed. It has no cumulative action; the system is not readily rendered unresponsive to its action. It may be given with cardiac tonics.

The conclusions of Dr. Geisler are that diuretin unquestionably increases the blood-pressure, as he has found no exception to this in all of the few cases included in his observations, and he feels bound to include the drug among the cardiac stimulants, as well as among diuretics.

In patients with valvular disease its action was most satisfactory; less so in affections of the heart's muscle. In the latter cases its action was that of a diuretic chiefly.

In acute nephritis its action was much greater than in chronic nephritis, as shown by the increase in the urine and the rapid disappearance of the œdema.

In one case of cirrhosis of the liver it caused no diuresis; in a healthy person it increased somewhat the twenty-four hours' urine.

It is probable that the salicylate of sodium also contributes to the diuretic action, and that this is not the result of the theobromine alone.—*Berliner klinische Wochenschrift*, 1891, Nos. 16 and 17.

Dr. Aug. Hoffmann has found diuretin an energetic diuretic, especially in cardiac dropsy; it reaches its maximum effect on the second to the sixth day. As regards its action upon the heart he is not in accord with Schröder or Gram, since he finds the heart's action is made more regular and stronger

by it; as a substitute for digitalis it will not answer, though it may well be given with it.

As a substitute for caffeine, as a diuretic, it will be found serviceable.

It is best given in solution, since it will not keep in the form of powder when exposed to the air for some time.

The carbonic acid of the air decomposes diuretin into insoluble theobromine. Fifteen grains in a tablespoonful of water, or—

℞.—Diuretin	ʒjss.
Aq. menthæ pip.	℥iij.
Syr. simpl.	ʒj.

Sig.—One tablespoonful five or six times a day.

All acid solutions and fruit syrups are to be avoided in prescriptions containing diuretin. In all cases it is best to have the solutions freshly made, as they decompose after a few days.—*Therapeutische Monatshefte*, 1891, No. 5.

Death after Salol.

Salol is usually considered a tolerably innocuous drug, but there are not wanting clinical observations which tend to show that, under certain circumstances at least, its use may be followed by dire results. Thus a case was some time ago reported by Aufrecht and Behm, in which death followed its use in acute endocarditis, and more recently Dr. Chlapowski has published in a Bohemian medical journal an account of a case in which a similar fatal result followed a fifteen-grain dose ordered to a patient who was suffering from severe gastric symptoms, and who was being examined by Ewald's method. After taking the salol the patient became restless and unconscious, the pupils dilated, the pulse became irregular, there was constant vomiting, and the urine became dark and contained salicylic acid. Death occurred twelve days later. At the autopsy there were found gastritis and hemorrhagic enteritis, a gastric ulcer cicatrized at the cardiac end, chronic endometritis, and a cyst of the ovary. No doubt was entertained that the salol had caused the symptoms of poisoning.—*Lancet*, May 23, 1891.

[In such cases the early use of the soluble phosphates, such as Glauber's salt, should not be omitted.—Ed.]

Hypodermic Injections of Carbolic Acid in Acute Articular Rheumatism.

In 1875 Senator published a paper in which he pointed out that marked alleviation of the local and some amelioration of the general symptoms quickly followed the hypodermic injection of a strong solution of carbolic acid into the neighborhood of the affected joints. This was accomplished without any appreciable ill effects to the patient.

Dr. A. L. Gillespie has tried this treatment in about twenty-four cases, and publishes notes of five of them.

He injected from four to ten minims of a 10 (?) per cent. solution of carbolic acid. [As carbolic acid is not sufficiently soluble in water to make a

10 per cent. solution, some other solvent must have been added to the water. —ED.]

A grain of the pure acid may be given at a dose.

In some cases the relief is speedily afforded, and the patients often begged for a repetition of the injection when another joint became painful.

It is said to be of special value in cases of gonorrhœal rheumatism in which no relief has followed the use of salicylates, but does not seem to act so well when many of the joints are affected.

It is best to pass the point of the hypodermic needle through the skin obliquely, and judging where the synovial membrane is, to inject the fluid as close outside the sac as possible.

Injected into the sac itself a 10 per cent. solution of carbolic acid precipitates the albumin present in the serous contents.

The *rationale* of the rapid disappearance of all the symptoms is, first, that it is due to the powerful local anæsthetic action of the acid; secondly, to some slight specific action against the rheumatic poison exerted by it.—*Medical Press*, 1891, No. 2719.

MEDICINE.

UNDER THE CHARGE OF

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MALARIA ON THE GOLD COAST.

DR. W. T. PROUT, in *The Practitioner*, No. 291, 1891, states that the varieties of malaria met with on the Gold Coast of Africa are the same as elsewhere, but there is a tendency toward irregularity and severity in type, especially among Europeans. Well-marked quotidian, tertian, and quartan ague is rare, and met with among natives or in Europeans who have been long resident on the Coast, in whom the type approximates more closely to that observed in the native. In such cases the attack is essentially mild, of sudden onset, with shivering or chilliness, rapid rise of temperature to 104° or 105°, with headache, lumbar pain, etc., followed by a copious sweat and return to health on the next day. In natives, constipation and hepatic torpor are frequently associated, and the attack can be cured by a dose of blue pill. In newly arrived Europeans the attack is usually more severe, and comes under the head of bilious remittent. The cold stage is usually not observed, nausea is invariably present, and frequently vomiting forms a dangerous symptom.

Besides splenic enlargement and tenderness, there is tenderness over the pyloric end of the stomach, and at times along the hepatic margin of the ribs. The stools are dark bottle-green in color and offensive. The attack lasts four to six days, leaving the patient in a very exhausted and anæmic state, from which he slowly recovers.

The third type is the hæmoglobinuric form, which is fortunately the rarest, as it is the most severe and the most dangerous (*Lancet*, 1891, No. 3544). It rarely occurs in Europeans who are in robust health, but in those who have become debilitated and anæmic from repeated attacks of fever, or from mental worry or alcoholic or other excess. Dr. Prout inclined to associate it more particularly with any cause which interferes with the action of the liver, as he has seen it occur several times in beer-drinkers. The onset is sudden, accompanied, it may be, with slight shivering. Vomiting commences early, and is a prominent and intractable symptom throughout. At first it consists of bile, and latterly merely of the liquids imbibed, mixed with dark-green, shreddy particles. The tongue and breath are foul, and there is great thirst The skin, conjunctivæ, and buccal mucous membranes are of a bright canary-yellow color. The temperature need not necessarily rise very high, and may even fall to normal, though the other symptoms persist. If after this there is a constantly rising temperature without remissions, the prognosis is unfavorable. The state of the urine early attracts the patient's attention. In the worst cases it is of a dark porter-like color, is almost syrupy in consistence, froths easily, and stains the sides of the vessel containing it a bright crimson. At this stage boiling and nitric acid show the presence of considerable quantity of albumin. A copious deposit forms on standing, which is seen to consist of pigment granules and pigment casts from the kidneys. A few blood-cells may be present, but they are not common. The quantity of urine is generally diminished. Recovery may take place, and in this case the general symptoms improve, the urine gradually becomes less high colored, increases in quantity, and becomes loaded with urates. Convalescence is naturally slow, and departure from the Coast is indicated. On the other hand, the symptoms may become aggravated; the urine diminishes in quantity, although the color generally improves, and total suppression may take place. Death in these cases results in from three to five days from uræmia and exhaustion.

The blood was examined in ten cases, partly native, partly European. They include two cases of bilious remittent, one of hæmoglobinuria, the rest being of the mild remittent type.

In eight cases distinct changes were observed in the red corpuscles. These were of five kinds:

1. Brightly refracting, rod-like bodies occurred in three cases, and in one of them were very numerous. They varied considerably in number and size, and appeared to possess a certain power of movement, which was possessed also by the other intra-corpuscular forms, which was rather pulsatile than an an amœboid movement, although occasionally a slow alteration of their position in the corpuscle took place.

2. Brightly refracting round spots of various sizes, sometimes combined with the rods in the same corpuscle.

3. Large circular bodies, like vacuoles, lying in the centre or at the side of the corpuscle. Rods may also be seen along with these.

4. Irregular bodies, which may be regarded as transition stages between the above forms.

5. In three cases there were peculiar bodies, which were more like a tadpole or spermatozoön than anything else—possessing, as they did, an oval head with a tapering filament attached to it.

All these forms were characterized by an absence of pigment, which does not agree with other observations. It is possible, however, that the examination of a larger number of cases may result in the discovery of intra-corpuscular pigmented bodies, such as Osler describes.

Pigmented bodies were noticed in five cases:

1. Small corpuscles, about the size of a leucocyte, containing dark-brown pigment granules, distributed evenly throughout the cell.

2. Bodies two or three times the size of a leucocyte, containing similar granules of pigment, but arranged around clear spaces.

3. Pigmented bodies, showing amœboid movement.

4. Amœboid bodies containing large masses of black pigment. These bodies differ from those just described in the character of the pigment, which is in masses instead of fine granules; they are probably the phagocytes on whose scavenging properties Carter lays so much stress. It is possible, however, that all these forms are merely different stages of the same body. The pigmented crescents or spheres described by Laveran were not met with.

With reference to the time of occurrence of these bodies, it may be observed generally that the intra-corpuscular forms were present before the paroxysm and while the temperature was rising, and usually disappeared under treatment; while the pigmented bodies were found at all stages, but persisted for a considerable time after the attack had ceased. In one case the whole of the bodies were found; in one rods, clear spots, and pigmented bodies; in one rods, vacuoles, and pigmented bodies; in two vacuoles and tadpole bodies; in three vacuoles only; and in two pigmented bodies only. The effect of quinine in the cases in which examinations were made appeared to be the disappearance of the intra-corpuscular bodies. These observations, then, are of value as corroborating, to some extent at least, the results obtained elsewhere.

As regards the efficacy of quinine in the treatment of malaria, the author considers it the only drug which can be relied upon. Considerable stress is also laid on the influence of the state of the liver on the action of quinine. Thus: "It has been pointed out that quinine forms a salt with the bile which is sparingly soluble, and in practice it is frequently found that it is useless to administer quinine, and, in fact, that it has a distinctly prejudicial action, until the liver has been acted upon by a large dose of calomel or blue pill, which may even have to be repeated before satisfactory results are obtained. I have before me the records of several cases where a cholagogue had to be administered twice or thrice before there was any improvement in the condition. We must remember that we have to deal not only with the malarial organism, but with the results of blood-destruction which themselves are sufficient to cause a rise of temperature, as seen in cases of paroxysmal hæmoglobinuria at home, and in the febrile attacks of pernicious anæmia. The liver, which appears to be the main element in the removal of these morbid products, eventually becomes loaded with them,

which is seen on examination in the altered condition of the liver-cells. These are found to be filled with a fine yellow pigment, which is quite different from the melanæmic pigment, and which has quite different microchemical reactions, blacking with ammonium sulphides, and giving the Prussian-blue reaction on the addition of potassium ferrocyanide and dilute hydrochloric acid. It is evident, therefore, that until we assist the liver in getting rid of these morbid products other treatment will have little effect. Quinine can only be regarded as a poison to the malarial organism, killing it and preventing its further development. There are, no doubt, certain cases in which quinine entirely fails; but they are rare, and I believe are not pure cases of malarial fever, but probably associated with some obscure complication often connected with the state of the intestines."

Quinine in small doses taken over prolonged periods is recommended as a prophylactic. The treatment of the cachectic condition found in tropical climates is another matter. The condition more nearly approaches that of pernicious anæmia, and the most useful drug is arsenic in large doses, or, better than any medicine, removal to a cooler climate. Antipyrine and sulphonal have also been found useful adjuncts.

An Epidemic of Gastro-intestinal Catarrh.

Dr. G. M. Lowe, of Lincoln, refers to an epidemic of this complaint which occurred at the conclusion of the severe frost experienced last winter. According to observations in his own practice the affection occurred only among adults, the symptoms being epigastric pain, vomiting, frequent copious feculent discharges of a successively whitish-green and yellow color; sometimes considerable tenesmus, a dull yellowish color of conjunctivæ; the tongue furred, moist, and viscid; temperature seldom above 102°; anorexia, and great nervous prostration. In no instance any mucous, bloody, or typhoid stools. Complications were: jaundice in 3 cases, severe labial herpes in 7 cases, and bronchitis in 2 elderly persons, who both died; 132 recovered.

Two possible causes are discussed, viz., rapid and great alterations of temperature and pollution of drinking-water, the writer inclining, on the whole, to the former view.

[At the same time cases of an altogether similar type were very prevalent in London.—Ed.]

Influence of Carbohydrates upon Proteid Metabolism.

To determine if the loss of flesh which occurs in cases of diabetes is due to a failure of carbohydrate-metabolism, Graham Lusk, Ph.B. (*Zeitschr. f. Biologie*, Bd. xxvii. p. 459), has endeavored to ascertain if a person in normal health, from the diet of whom the carbohydrates were withdrawn, would present the increase in proteid and fatty metabolism that takes place in diabetic patients. With this end in view, he partook, for three days, of a known amount of albuminoids, fats and carbohydrates; and, for another three days, of the same quantity of albuminoids and fat as in the first experiment, but omitting the carbohydrates; in each instance determining the amount of nitrogen excreted in the urine and feces. As a result, he found that, under the latter conditions, the amount of nitrogen eliminated was 36 per cent.

greater than under the former. Repeating the experiments, using in both, however, less than half the amount of nitrogen used in the first series, he found that the amount of nitrogen eliminated was greater than that ingested, the amount eliminated being increased 32 per cent. when carbohydrates were withheld. The inference is that the omission of carbohydrates from the food brings about a marked increase in proteid metabolism, and, conversely, that the destruction of carbohydrates tends to protect a certain amount of albuminoid matter. The excessive elimination of nitrogen, shown to take place in cases of diabetes, may be explained by the excretion of sugar in the urine, and it is highly probable that the failure of sugar-decomposition in the system is the cause of the loss of flesh. That the amounts of oxygen consumed and carbonic acid given off by diabetics and healthy persons, under conditions otherwise similar, are respectively alike, is indicated by the fact that the number of heat units produced to the cubic metre of body surface is the same in both. The oxygen used in health to burn sugar is in the case of diabetes used in the destruction of fat, of which destruction there is said to be a relative increase.

Potassium Cantharidate in Lupus.

Saalfeld (*Deutsche med. Wochenschr.*, March 12, 1891) presented a case of lupus, in which, after five injections of potassium cantharidate, the masses were reduced in size and paler than before.

Landgraf did not find the course of acute affections of the larynx shortened by the use of the remedy. From the results of its application in five cases of chronic disease, he concluded that its use, even in small doses, gave rise to an inflammatory œdema of the laryngeal mucous membrane, which disappeared rapidly.

Lublinski had treated sixteen cases of pulmonary and laryngeal tuberculosis of moderate severity, with a varying number of injections. The application of the remedy is painful in most cases, and more painful from the use of the potassium than of the sodium salt. In two cases, strangury occurred after the second injection; in one, after the third. Neither albumin nor blood was found in the urine. In one case the sputum became blood-streaked for the first time after the third injection; in another after the fourth. Some patients felt a sense of warmth in the throat. The majority stated that the cough was looser and the expectoration freer. After the second, third, or fourth injection, the seat of the disease in the larynx appeared hyperæmic and covered with thin secretion. In one case there was dysphagia. The infiltration, especially of the inter-arytenoid fold, receded in most cases, and the voice improved. In one case, an inter-arytenoid ulcer, and in another, after seven injections, ulceration of the right vocal band healed; in a third case, after two injections, an ulcer at the free margin of the left band became progressively smaller; in a fourth, an arytenoid ulcer had almost entirely disappeared, after four injections had been made. In a case presenting, in addition to pulmonary and laryngeal tuberculosis, lupus of the dorsum of one hand, it was stated that the pains of the latter had disappeared after the fourth injection.

Cantharidin.

Conceiving that the transudation of serum from a healthy capillary caused by cantharidin would be greater from a vessel in an abnormal condition, Liebreich (*Deutsche med. Wochenschr.*, March 5, 1891) endeavored to determine the dose which would cause from capillaries of lowered resistance the same degree of exudation as occurs from normal vessels after larger doses. The results he reported at a meeting of the Berlin Medical Society. If the hypothesis is correct, some influence would be exerted upon pathological processes resulting from local irritation of bacillary or other nature. One-fiftieth of a milligramme of potassium cantharidate was injected into the back of a patient with a tumor of the œsophagus. Expectoration became easy and was increased as the dose was increased. It was determined that 0.0006 was the most that could be given without causing local phenomena, while there was strangury and the urine contained blood. The most suitable dose was 0.0001 or 0.0002. In cases of laryngeal tuberculosis, marked improvement in the voice was perceptible after the second injection. The patients may continue their occupations. The injections are made on alternate days. The bladder and the rectum must be looked after. Diarrhœa or burning micturition indicate a withdrawal of the injections. The remedy is prepared by dissolving 0.2 gramme of pure cantharidin and 0.4 gramme of potassic hydrate in 20 c.cm. of water, and heating in a water-bath until a clear solution results. If sufficient water is added to make a litre, every cubic centimeter contains 0.0002.

Heyman reported that he had observed striking improvement in the voice and in the general condition in severe cases of laryngeal tuberculosis, usually after the third or fourth injection, given daily. No influence upon the number and appearance of the bacilli was observed. In three cases the râles had diminished or disappeared. In one case the area of dulness had diminished, expectoration became easier and less frequent, the sputum thinner, and the cough moderated in frequency and intensity—in four cases it almost entirely disappeared. Night-sweats occurred less frequently or ceased. Redness and infiltration of the larynx diminished. The granulations became pale and flat; the ulcers cleared up and became smaller from the periphery. A number of well-defined ulcers had healed; others were in process of cicatrization. In some of the worst cases acute exacerbations occurred. Rapid improvement was also observed in a number of cases of catarrhal affections.

B. Fränkel has treated fifteen cases, mostly severe. He found the injection painful, though submitted to by the patient, the pain disappearing in a day or two. The usual symptoms following the internal administration of cantharidin were observed—strangury and tenesmus. The general condition improved, the voice returned, infiltration receded, and ulcers cleared up and healed.

A Method of Accelerating Desquamation and therefore of Shortening the Infective Period in Scarlatina.

Dr. W. Allan Jamieson, of Edinburgh, advocates the use of resorcin on account of its well-known action of causing the outer layers of the epidermis to separate without injury to the deeper ones. A 3 per cent. resorcin-sali-

cylic-superfatted soap was employed, and when used, with warm water, from the commencement to the close of desquamation a notable diminution in the period of "peeling" was observed.

From the consideration of a large number of unselected cases the conclusion has been arrived at that, while the commencement of desquamation may be as early as the fourth day of the disease, or may, in exceptional instances, be delayed as late even as the sixteenth, the average day on which it is first visible is the ninth. Again, from the onset of the disease till the completion of desquamation in sixty-two unselected cases the average was 55.5 days, no treatment having been employed to interfere with the natural process. But when washing with the resorcin-salicylic soap was begun as soon as signs of desquamation could be noticed, or shortly before, the desquamation was entirely completed in 40.26 days. There is thus a gain, on the average, of more than a fortnight. In two cases washing with the soap was practised on only one side of the body, a commencement being made in one three, in the other four, days prior to the appearance of any trace of scaling. In the case in which the right side was washed, peeling began on the right palm, and then subsequently on the right side of the trunk and limbs; in that in which the left side was so treated, the left palm, then the left side of the trunk and limbs, showed the earliest indications of desquamation. In all cases it was found advantageous, after washing with the soap and drying the body, to smear on a small quantity of some bland oil, such as olive, almond, or purified whale oil. The nurses, too, found it necessary to protect their hands with India-rubber gloves, or to use a sponge carefully in washing the patients, else their palms became tender from a thinning of the epidermis. Such of the patients, also, who were old enough or far enough advanced in convalescence to wash themselves, noticed that the hand used in washing desquamated earlier than the other.—*Lancet*, 1891, No. 3550.

Convulsions as a Cause of Cerebral Hemorrhage in Early Life.

Dr. Henry Ashby, of Manchester, reports a case which, in his opinion, strongly supports the view that a series of convulsions may give rise to a multiple hemorrhage.

A boy, aged twelve years, was admitted to hospital suffering from tuberculosis and old hemiplegia. He was well and strong until two years old, and free from hereditary taint. At this time he had a fit, followed by unconsciousness for ten minutes, attributed to eating pie-crust. Two weeks later he had another more severe fit, lasting half an hour, affecting especially the right arm and leg. After this the right arm hung useless, and he dragged the right leg in walking. Both limbs have recovered to some extent, but have remained more or less stiff and rigid. From this time until ten years of age he had two fits a week on an average. There was no evidence of mental weakness. He died of tuberculosis in February, 1891. The brain was examined on the following day. The outer surface was normal everywhere.

A section made exposing the lateral ventricles, without slicing the corpus striatum, showed an old cyst with brownish contents, § inch in length, situated on the left side in the white substance between the fissure of Rolando and the corpus striatum; and four small cysts, situated on the right side in

the white substance. One cyst was apparently about ½ inch in depth. There was no sclerosis or induration in the neighborhood of the cysts. A third section, made lower than the above and on a level with the upper surface of the cerebellum, and slicing the optic thalamus, caudate nucleus, and internal capsule, showed the lower limit of the cyst just described, a second old blood-cyst, and another small one. Another similar cyst was found in the white substance of the frontal region at a lower level.

Sections of the cord made in the cervical, dorsal, and lumbar regions did not show any sclerosis or wasting of the descending tracts, neither was there any wasting of the internal capsule or crura.

In reviewing the history of the case in the light of the morbid anatomy, there seems to be little room for doubt that the initial convulsions were the cause and not the consequence of the multiple hemorrhages. It is hardly conceivable that these should be caused by any thrombosis, embolism, or arteritis; they must presumably have been due to a sudden engorgement of the veins due to asphyxia, in consequence of spasm of the respiratory muscles.

Cases of this kind are by no means uncommon, and the view put forward in this communication has been expressed by several recent writers, among others by Goodhart, Osler, and Angell Money.—*Practitioner*, 1891, No. 276.

The Influence of Diseases upon the Respiratory Interchange of Gases.

To determine if disturbances involving the exchange of gases between the air and the blood, and if anomalies of tissue metamorphosis in conjunction with which the need of oxygen or the capability of the tissues to unite with oxygen may be altered, do in reality materially influence the respiratory interchange of gases, Kraus and Chvostek (*Wiener klin. Wochenschr.*, Bd. iv. 1891, p. 33) made forty observations in twelve persons with various forms of anæmia (pernicious and secondary anæmia and chlorosis), leukæmia, and the carcinomatous cachexia. Under ordinary conditions no aberration from the normal was observed in the gaseous interchange. The taking of nourishment invariably augmented the interchange, as happens also in healthy persons during digestion. In a small number of cases muscular activity increased the combustion of oxygen and the production of carbonic acid, but not in the same degree as in health; in the anæmic patients, the respiratory coefficient (which normally arises) was lowered.

To determine the activity of the bodily oxidation, benzole was administered to six patients with diabetes, anæmia, carcinoma of the stomach, and leukæmia, and the quantity of phenol excreted was measured. The proportion of phenol was found small in conditions of impaired nutrition, but no special change was observed for any single affection.

In investigating the influence exerted upon the respiratory process by an increased volume of oxygen in the inspired air, an admixture of ten volumes of nitrogen and ninety volumes of oxygen was used. The subjective condition of healthy and ill persons was not materially influenced by the continuous breathing of such a mixture; nor did objective manifestations appear. During the first ten minutes of easy breathing a considerable increase in the comparative quantity of oxygen absorbed was noted; subsequently the absorp-

tion of oxygen fell to the normal or lower. That this primary increase took place in anæmic patients with a decided deficiency of hæmoglobin makes it evident that the excess of oxygen taken up combines with the tissues. For a short time at the beginning of the experiment the exhalation of carbonic acid was increased, though not in the same degree as the absorption of oxygen. These observations indicate that there is no more substantial basis for the employment of oxygen in disease than has hitherto existed. Clinically, inhalations of oxygen were inefficacious. The most important indication for such a measure would be the sudden occurrence of respiratory insufficiency.

SURGERY.

UNDER THE CHARGE OF

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Surgical Treatment of Piles.

On the basis of 200 cases of operation on hemorrhoids, ALLINGHAM (*Medical Press and Circular*, 1891, No. 2724) discusses the surgical treatment of this disease.

He divides hemorrhoids into two groups: the first including those which come down at stool, and those which are almost always in a state of prolapse and bleed profusely at each act of the bowel. In this class of cases the quickest operation is the best, since as a result of long-continued hemorrhage there is always considerable anæmia, and therefore it is of prime importance that as little blood as possible should be lost from the operation, and that there should be a minimum of risk of secondary hemorrhage. These requirements are fulfilled by the ligature, which can be applied in a very few minutes and is practically free from any danger of after-hemorrhage.

The second group comprises those piles which are chiefly troublesome because of the inconvenience they occasion, since they are prone to come down and prevent the patient taking any active exercise. These piles rarely bleed and do not otherwise interfere with the enjoyment of good health. Here the great point is to select the least painful operation. The best modes are crushing or simply cutting off the piles and picking up any vessels that may bleed.

In the operation of ligation with incision the pile is drawn down by a vulsellum and separated from the muscular and submucous tissues upon which it rests. The incision is made upon the skin at the junction of the

mucous membrane, and is carried up the bowel, so that the pile is left connected by vessels and mucous membrane only. A strong silk ligature is then tied as tightly as possible, and the ligatured pile is returned within the sphincter.

This method is very well suited to piles which are large and vascular and are inclined to be sessile rather than pedunculated. It should be applied to patients who have any tendency to cardiac or kidney disease, or where there is a thrombosed condition of the vessels. It is the best to use when patients are feeble. Ligature is, in fact, the safest operation. Its drawbacks are that the wound takes some time to heal, there is more pain after operation and on the first motion of the bowels, than after crushing or simple excision. There is more sloughing and suppuration until the ligatures have separated, and hence there is greater liability to some contraction.

The crushing operation consists in drawing the pile by means of a hook into a powerful screw-crusher, which is tightly screwed up, and distal end of pile cut off. The crusher should be applied on the longitudinal aspect of the bowel and should be left on the pile for about two minutes. This operation should be used when the piles are medium-sized and rather pedunculated, and the patients are in good health; but in bad cases it is not so safe as the ligature. In ordinary cases its advantages are that there is freedom from pain after operation; retention of urine is of rare occurrence; suppuration is not likely; there is little or no pain on the first action of the bowels, and recovery is usually rapid; after-contraction is not common. The clamp and cautery are not favored by Allingham. He states that statistics show that it is quite six times as fatal as ligature or crushing; and burning gives more pain after operation, as is the case with all burns. Hemorrhage is more likely to occur, there is greater sloughing of the rectal tissue. More time is required for healing and greater contraction is common, as is also the case with all burns. The excision of piles is best applied to one prolapsed pile, to the single perineal pile, so common in women, or to one pile which is complicated with fistula, ulcer, fissure, etc. As a rule, one or two vessels require clipping. It is, therefore, inexpedient to excise many piles, for there may be trouble in picking up the divided arteries.

Allingham believes that Whitehead's excision method—that is, removal of the entire pile area and stitching of the healthy bowel above to the sphincter—is rarely necessary. It is a slow and bloody operation, and is at times followed by contraction. Few cases are really well under three weeks after operation, and premature resumption of the ordinary ways of life may cause a greater tendency to contraction, or, what is worse, troublesome and tedious ulceration may supervene and take months to heal.

Fixation in the Traction Treatment of Hip Disease.

Attention is called by Lovett (*New York Medical Journal*, vol. liv., No. 6) to the important place which fixation should occupy in the traction treatment of hip-joint disease. The ordinary traction splint now commonly used is a device which gives passive motion without friction. Fixation was not considered one of its attributes. The author has many times shown that this splint allows of very wide motion in mild cases of hip disease. Where joint

motion is not painful in a fairly wide arc, motion within the limits of that arc is not wholly harmful. In cases where the disease is severe, and where the patient is constantly and harmfully active, the ordinary traction splint is not followed by good results. With the idea of combining traction and fixation, Lovett has devised a splint which should be bent to fit the curve of the back; practically it is a combination of the Taylor and Thomas splints, and has the hip-band of the Taylor splint with two perineal bands, and the leg-piece is in a measure like the Thomas splint, excepting that it is prolonged beyond the foot to end in a traction apparatus. The splint does not attempt to force the leg into position by using the lever principle; it simply aims to make a traction, and while doing this it fixes the hip as much as can be done by any portative appliance. By means of the pelvic band this splint firmly holds the leg, pelvis, and thorax.

The author uses this appliance where sensitiveness of the hip is present to any extent, where the temperature is high, or where there is much induration of the soft parts—in short, in all bad cases. In addition, he applies it to unruly children, and to those whose parents are ignorant or shiftless.

Fixation in bed is desirable when sensitiveness occurs in the joint or malposition in the limb begins to appear. Statistical study seems to show that fixation in bed, when malformation occurs, not only is an important means of cure of this malposition, but serves to prevent the occurrence of abscesses in a very large proportion of cases.

Laparotomy for Wounds of the Liver.

Broca (*Le Mercredi Medical*, 1891, No. 29) reports two cases of wound of the liver, each treated by surgical intervention, and each terminating fatally.

The first patient was seen six hours after the infliction of the stab wound. He exhibited the symptoms of large hemorrhage. The wound was enlarged; the source of bleeding was found to be the liver; blood was flowing freely from the incision upon the anterior surface of this organ. An attempt to suture this wound proved futile, the threads tearing through. Thermo-cautery also failed to check the bleeding; an iodoform tampon was, however, entirely successful. An hour was consumed in the operation.

The patient perished two days later of abdominal septicæmia.

At the autopsy several other wounds were found, in some of which there had been bleeding after operation.

The second case was also a stab wound. The patient was seen four hours after the injury, and presented all the symptoms of intra-peritoneal hemorrhage. The abdomen was opened and a non-penetrating and penetrating wound of the stomach were found. A wound three inches long was observed on the lower surface of the liver. By means of a silk suture this wound was closed and the bleeding ceased. The patient died in a few hours with symptoms of continued hemorrhage.

At the autopsy it was found that the knife had passed completely through the liver, the wound of exit being located on the upper surface of this organ one-fifth of an inch behind the suspensory ligament. From this source sufficient blood flowed to entirely fill the pelvis.

Contribution to the Knowledge of Sarcoma.

Coley (*Annals of Surgery*, vol. xiv., No. 3) reports a case of round-celled sarcoma of the metacarpal bone, which he treated by amputation of the forearm about four months after the observation of the first tumor. In a little more than a month there was general dissemination of the disease, and death followed six weeks after the operation.

Coley has made a careful analysis of 90 unpublished cases of sarcoma, embracing nearly all those treated in the New York hospitals for the last fifteen years. He succeeding in obtaining the subsequent histories of 44. Of these 9 were living at periods ranging from three to ten years after operation, and 4 were living free from recurrence twelve to eighteen months after operation.

The chief characteristics of subperiosteal sarcoma are: there is usually a history of traumatism; the pain precedes the tumor and remains throughout the disease; the tumor is usually fusiform and seldom encapsulated, there being rapid infiltration of the surrounding tissue; it increases rapidly in size; the skin is discolored in the later stages; there is a slight elevation of temperature and an abnormally rapid pulse, and that there is very little tendency to ulceration.

After citing Brune's famous paper upon the curative influence of erysipelas upon sarcoma and carcinoma, Coley reports 3 cases of sarcoma in which inoculations of pure cultures of erysipelas streptococcus were employed. These inoculations were made repeatedly and were followed by local reaction; the tumor seemed to be distinctly lessened in size. No cures are mentioned. To the 5 cases collected by Brune, Coley has added 6 others in addition to the 3 he inoculated: 6 were cured and 2 were greatly improved.

Craniectomy for Microcephalus.

Victor Horsley (*Internat. klin. Rund.*, v. Jahrg., No. 38), after a careful review of the subject of craniectomy for microcephalus, and after a report of 2 cases, concludes that operative treatment in cases of microcephalus and synostosis is fully justifiable, since the condition is in itself absolutely hopeless, and since surgical intervention has been followed by decided improvement. There are, of course, in these cases special dangers, but these may be limited by restricting the operation both in time and extent.

The Results of Radical Operation for Non-strangulated Hernia.

Lucas Championnière (*L'Abeille Médicale*, 48 an., No. 43) states that he has performed 254 operations for the radical cure of non-strangulated hernia, beginning this series of cases ten years ago. Of this number but two perished —one because he was in very bad condition, the other because of internal strangulation. In spite of this excellent result, in so far as life is concerned, the operation is found useless and fatal unless it is undertaken under certain definite conditions and carried out under a well-considered system.

The results of operation have been excellent. The greater number of patients have not been compelled to wear trusses or supports; or, in less favorable cases, this has been found necessary for not longer than two months.

The indications which have been fulfilled in the radical operation are: 1. As extensive an ablation of the peritoneum as possible. 2. Removal of as much omentum as can be reached, or can be drawn into the sac. 3. Formation of a strong and extensive cicatrix in the hernia region.

Of the 254 cases 222 were inguinal, 14 were crural, 17 were umbilical, 1 was traumatic. The most satisfactory results in the operations upon inguinal hernia were obtained in cases of the congenital form of this rupture.

The results of radical cure of umbilical hernia are said to be particularly satisfactory.

The author believes that the radical cure of reducible hernia should be the rule and not the exception. In very young infants, however, he does not counsel operation, not because such cases can be cured by other means, but because the tissues are not sufficiently firm to make a reliable cicatrix. After the sixth and seventh year, however, the operation is strongly advised. In old persons operation should be avoided unless there are pressing reasons for resorting to the knife. Finally, even those of the proper age—that is, between seven and forty, should not be operated upon when the abdominal walls are weak, or there is a tendency to giving way in several regions. Congenital inguinal hernia invariably should be operated upon. This admits of no exception. The same rule applies to all hernias in young women.

[Since the operator began this series of cases ten years ago, he might furnish valuable figures in regard to the ultimate effect of hernial operation. This, unfortunately, he neglects to do.—ED.]

OPHTHALMOLOGY.

UNDER THE CHARGE OF

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SYMPATHETIC OPHTHALMIA NOTWITHSTANDING RESECTION OF THE OPTIC NERVE.

DR. A. TROUSSEAU reports a case of this kind in the *Revue Générale d'Ophthalmologie*, Tome x., No. 3. The exciting eye had been wounded by the blow of a stone six years before, and after remaining quiet three and a half or four years became again troublesome, and he applied to have it removed. It was shrunken, red, the seat of violent cyclitis. The other eye, except for the excessive secretion of tears from time to time, was absolutely healthy, with full acuteness of vision.

On account of the slight deformity, and the previous long period during which it had remained entirely quiet, it was judged an especially appropriate case for resection of the nerve, rather than enucleation. Accordingly, the

nerve was resected, the piece removed measuring four or five millimetres in length, and the parts bathed with a sublimate solution 1 : 2000. The operation was followed by protrusion of the globe, which lasted but three or four days; at the end of ten days the eyes were in very satisfactory condition, the sound one relieved of its attacks of lachrymation, and on the twentieth day he was discharged and the case reported as a cure in the *Bulletin des Quinze-vingts* for 1890.

Within two months after his discharge the patient returned with redness of the better eye. He was put upon mercurial inunctions, which he used regularly for three weeks, when he returned with vision reduced to counting fingers at two metres, iris inflamed, and vitreous opacities. The exciting eye was then enucleated, and after four or five days the other began to improve. When the case was reported at the end of three weeks after the enucleation, vision had risen to one-half the normal.

Transplantation of the Cornea.

Von Hippel reports in the *Berliner klin. Wochenschrift*, xxviii. Jahrg., No. 19, his seventh case subjected to this operation. The patient had a dark-brown opacity which covered the pupil, and which had been produced by repeated cauterizations of the cornea with nitrate of silver. He also had cataract. After extraction of the opaque lens, with iridectomy, he had vision equal one-fifth, but he insisted on the removal of the spot on the cornea. The corneal tissue, down to Descemet's membrane, was removed from a circle four millimetres in diameter, and replaced by the full thickness of the cornea from a young rabbit. The eye was afterward dressed with iodoform and both eyes bandaged. Although there was temporary clouding of the thin layer of original tissue behind it, the transplanted flap remained clear. In two weeks the epithelium was continuous from the cornea to the flap. After discission for a secondary cataract, the patient obtained vision equal one-third. It does not appear from the report that the transplantation caused any improvement in vision. But the operation deserves to be called successful in that it secured the continued life and health of the graft, and removed an unsightly scar.

Mercury in Syphilitic Disease of the Eyes.

Galezowski, in the *Recueil d'Ophthalmologie*, An. xiii., No. 3, points out that mercury administered by the digestive tract acts very rapidly on iritis, either plastic or gummatous, not that a radical cure is effected, but the ocular inflammation disappears. Not so with syphilitic choroiditis, which yields to no mercurial administered by the mouth, but is cured almost without exception by mercurial inunction.

It is still otherwise with the ataxic atrophies of the optic papilla, which are without doubt usually syphilitic. Here, unfortunately, any anti-syphilitic treatment gives unsatisfactory results. This Galezowski explains on the hypothesis that the action of such medicaments is slow in the case of certain affections occurring in closed cavities, as in choroiditis and affections of the spinal cord.

While iritis can be cured in two or three months, choroiditis requires two

years; and in the case of optic atrophy the disease outruns the treatment, and produces permanent injury before the cure can be effected. Probably by a course of daily mercurial inunctions, carried out for two consecutive years on the occurrence of the earlier lesions of syphilis, optic atrophy, cerebral syphilis, and such later lesions could always be prevented.

Herpes of the Cornea from Influenza Treated with Pyoktanin.

Galezowski (*Recueil d'Ophthalmologie*, An. xiii., No. 4) regards this affection as essentially one of the fifth nerve. It has been met with very frequently during the last two years in Paris, more particularly during the epidemic of influenza. The form of eye disease most commonly connected with the influenza was a phlyctenular conjunctivitis, or a superficial herpetic keratitis, with loss of epithelium, anæsthesia of the cornea, and which did not yield to the ordinary treatment for that affection. The two measures found to hasten the cure were the internal administration of large doses of quinine and the applications of apyonine or pyoktanin. The solution of pyoktanin, one part to one hundred parts of distilled water, was brushed on the cornea five or six times a day, and produced excellent and rapid improvement.

The Light-streak on the Retinal Vessels.

Van Trigt put forth the hypothesis that this streak was due to reflection from the anterior wall of the vessel or the anterior surface of the blood-column in the vessel, and this explanation was adopted by Jäger, Donders, and others. Loring ascribed it to refraction of the light passing through the blood-column and reflection from the tissues behind the vessel, and using a watery solution of carmine in a glass tube, he showed that under the conditions that exist in examining a retinal vessel the light-streak was seen when the tube was placed in front of a reflecting surface, and not seen when placed in front of a non-reflecting surface. Donders, however, claimed that the blood of warm-blooded animals was not transparent like the carmine solution, and therefore the conditions were essentially different in Loring's experiment from those the experiment was intended to elucidate. Dr. A. E. Davis (*Archives of Ophthalmology*, vol. xx., No. 1), repeating the experiment, but using the blood flowing from the carotid of a cat, obtained precisely the results reported by Loring with the carmine solution. This seems to prove conclusively that the light-streak does depend on the refraction of the blood-column and reflection by the tissues back of the vessel.

Platinum Instruments in Ophthalmic Surgery.

Dr. E. Gruening urges (*Archives of Ophthalmology*, vol. xx., No. 2) the use of such instruments on account of the ease with which they are sterilized. He has had cystotome, iris repositor, wire loop, spoon, iris and fixation forceps, and speculum made with the working parts consisting of an alloy of platinum and iridium. This alloy by hammering becomes very firm, can be polished, and is not blackened in the flame of a spirit-lamp. By heating to a white heat, such an instrument can be certainly sterilized by the operator at the time of operation, without his having to depend on the skill and care of an assistant.

Aniridia and Glaucoma.

E. T. Collins, F.R.C.S., reports in the *Ophthalmic Review*, vol. x., No. 114, three cases in which these conditions coexisted. It might be that in such cases at least glaucoma could not be due to closure of the filtration angle of the anterior chamber, and that some other explanation would have to be found for its occurrence. But in two of these cases of congenital aniridia, although no iris was visible, the ciliary body was found at the microscopical examination to end anteriorly in a rounded nodule that had become applied and adherent to the filtration space of the cornea in such a way as to block it entirely. In the third case, although the iris had been entirely torn away by traumatism and the ciliary muscle was atrophied, the most anterior of the ciliary processes was intimately adherent to the region of the cornea in question. Exceptions of this kind may truly be said to prove the rule that glaucoma is due to blocking of the filtration area by the iris.

Gumma of the Conjunctiva.

Gumma of the conjunctiva is of rare occurrence, and partly on that account is very apt not to be recognized. Dr. Caudron (*Revue générale d'Ophthalmologie*, Tome x., No. 4) reports a case, and quotes a few others previously reported. In his patient, a man of forty years, giving no history, it appeared external to the cornea, the tumor measuring about ten millimetres in the horizontal, four millimetres in the vertical direction, and three millimetres in thickness. Its color was reddish-yellow, and it was surrounded by an area of vascularization. Its consistence was firm, being almost cartilaginous at the periphery. Thorough examination revealed numerous other evidences of syphilis. Placed on anti-syphilitic treatment, improvement was rapid. A complete cure was effected in two months, and there had been no subsequent manifestations. A study of the reported cases shows that the cure of such lesions is usually rapid and easy under appropriate treatment.

OBSTETRICS.

UNDER THE CHARGE OF

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The Pathology and Treatment of Puerperal Eclampsia.

In connection with the interesting paper of Herman (page 485 of the present issue of The Journal) the recent literature of eclampsia offers much of interest.

In a discussion on the subject at the British Medical Association during

the summer, GALABIN inclined to the uræmic theory of the causation of eclampsia. He quoted the statistics of Guy's Hospital, which showed an improvement in the mortality following the substitution of chloroform for bleeding. Mortality at present was reduced to 20 per cent. Moderate venesection, to relieve extreme vascular congestion, he thought advisable in some cases; bleeding to stop convulsions is inadmissible. BYERS had found the chloroform and chloral treatment, with the speedy termination of labor, most advantageous. AUVARD, of Paris, regarded eclampsia as caused by toxæmia, from failure of the emunctories. Treatment consisted in causing prompt and free elimination, in narcotizing the nervous system until the uterus can be emptied. SWAYNE had seen 36 cases of eclampsia in private consultations. In 24 bleeding was used, in 1 thirty ounces of blood were taken. The convulsions ceased, although other agents had failed. GODSON induced labor when albumin was abundant and urea deficient in the urine.

In general, the opinion was adverse to bleeding, except where marked engorgement was present; labor is to be induced when albuminuria and deficient urea are present.

PATHOLOGY OF ECLAMPSIA AND ALBUMINURIA, WITH REPORT OF A CASE.

VAN SANTVOORD (*Medical Record*, vol. xl., No. 8, 1891) describes the case of a patient whom he observed during two pregnancies, who had albuminuria and diminished excretion of urea. Symptoms of toxæmia were present during both pregnancies, and one eclamptic seizure occurred two months before labor, without apparent reflex cause. The patient bore two healthy children and recovered. The theory of toxæmia from deficient liver action, attended by diminished formation of urea, seems most rational to Van Santvoord. In the treatment of his case, nitroglycerin, digitalis, and citrate of potassium were efficient.

THE TREATMENT OF ALBUMINURIA AND NEPHRITIS IN PREGNANCY.

MIJULIEFF (*Geneesk. Cour.*, 1891, No. 18) has derived the following indications for treatment from three cases of nephritis in pregnancy in which the fœtus perished in the uterus: when a woman previously healthy shows symptoms of nephritis during the first months of pregnancy, abortion should be induced; in the second half of pregnancy it is rarely necessary to interrupt pregnancy, except for urgent symptoms. In chronic nephritis during pregnancy, labor should be induced in the interest of mother and child as soon as viability is possible.

THE TREATMENT OF ECLAMPSIA DURING PREGNANCY BY RAPID DELIVERY.

HAULTAIN (*Edinburgh Medical Journal*, 1891) treated four cases of eclampsia during pregnancy by ½ grain pilocarpine subcutaneously, with the external application of heat; croton oil; and 30 grains of chloral, followed by 10 grains every hour for four hours; milk diet; 5 minims of tincture of digitalis thrice daily, and saline purges were also continued. Haultain performed delivery as soon as possible, in the following way: after the patient

has perspired freely and been purged and has taken 30 grains of chloral the previous evening, she is deeply chloroformed and the cervix is dilated by the fingers; the membranes are ruptured, and the child is delivered by forceps. From sixty-five to ninety minutes were required to dilate the cervix; the entire delivery consumed between two and three hours.

The Operative Treatment of Eclampsia: Cæsarean Operation.

Swiecicki (*Der Frauenarzt*, 1891, Heft 9) performed Cæsarean section on a patient comatose in eclampsia, in whom the os and cervix were undilated and the child lived. The child was asphyxiated at delivery, and could not be resuscitated. The mother perished of pulmonary œdema. This is the tenth Cæsarean operation for eclampsia, six having been done in Holland, one by Von Herff at Halle, one by Rosthorn, and one by Müller at Berne. The operation is only justifiable when the child lives and the genital canal is entirely undilated.

A Successful Cæsarean Section for Eclampsia.

Von Herff (*Berliner klin. Sammlung klin. Vorträge*, Heft 32) advises the induction of labor when the upper portion of the cervix is dilated, and only the vaginal portion remains closed. When no dilatation is present Cæsarean section is indicated. In a case of severe eclampsia he operated by Cæsarean section; mother and child survived.

A Parasitic Monster.

Norris describes a parasitic monster, recently exhibited in Philadelphia, as follows:

The boy Laloo, a monster of the dipygus parasiticus variety, is nineteen years of age, and apparently enjoys good health. The parasite consists of the two upper extremities and a rudimentary pelvis with the two lower extremities closely joined together. It is attached to the boy firmly at the lower right side of the sternum near the ensiform cartilage by a bony pedicle surrounded by soft tissues and covered with integument, and hangs over the lower portion of the chest, the epigastric and right hypochondriac regions, the anterior surface of the parasite looking toward the abdomen of the boy. The skin contains venous capillaries, and is sensitive to touch, the degree of sensibility decreasing as the hands and feet are approached. The hands and feet are contorted, the feet being better developed than the hands. The fingers of the left hand are diminutive and webbed, those of the right hand are more developed, the phalanges being distinct. The glutei are separate and distinct, having between them a natal fold, in which can be found a trace of an anal aperture. The legs are flexed upon the thighs. Careful examination failed to discover respiratory murmur or cardiac pulsations. Coils of intestines could be felt. Discharge of feces from the parasite does not occur, and urination takes place without the boy's knowledge until after the urine has been voided. Perspiration and elevation of the temperature occur simultaneously with these phenomena in the boy. The sex of the parasite is undetermined, it being most probably a pseudo-hermaphrodite.

To pander to the morbid propensities of the curious, the managers of the museum have shrewdly clad the parasite in female attire. The boy, whose intelligence is quite remarkable, states that the surgeons who had examined him had generally decided that the removal of the parasite by surgical means would be directly dangerous to his life.

GYNECOLOGY.

UNDER THE CHARGE OF

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The Early Diagnosis of Cancer of the Uterus.

Winter (*Berliner klin. Wochenschrift*, 1891, No. 33) reviews the recent results of extirpation of the cancerous uterus in Germany, showing that the total mortality of the five principal operators is only 8.4 per cent., the lowest being Kaltenbach's (3.3 per cent.). Although a certain number of fatal cases is inevitable on account of the difficulty of absolutely eliminating sepsis, other dangers ought to be avoided by improved technique, so that the mortality can be reduced to 5 per cent. The statistics of high amputation are still better, the Berlin Klinik showing a mortality of 6.5 per cent. (in 155 cases) previous to 1884, since which time no deaths have followed the operation in 64 additional cases.

Unfortunately, the remote results of both operations have not been as favorable as could be desired. A local recurrence (in the cicatrix) can usually be expected within two years at the utmost, while recurrence in the lymph-glands and pelvic connective tissue occurs later. This difference has not been clearly defined in the statistics. According to the writer's observations, after high amputation 38 per cent. of the patients were well at the end of two years, and 26.5 per cent. had no recurrence five years after operation, after which time a return of the disease is exceptional. Fritsch has noted 36 per cent. of cures after vaginal hysterectomy at the end of five years, and Hofmeier 33 per cent. at the end of four.

Only a small proportion of the patients with cancer of the uterus are suitable cases for a radical operation (about 25 per cent.), and if one-fourth of these are cured, it follows that only 7 per cent. of the entire number of cancerous patients are cured. In other words, the diagnosis of malignant disease is not made at a sufficiently early stage, and this neglect is traceable to the general practitioner. "The physician to whom the patient first applies decides her fate in the majority of the cases." Hence it is extremely important that he should be familiar with the initial symptoms. Of these a watery vaginal discharge is the most constant, especially in carcinoma of the portio. Menorrhagia, in a patient whose flow has formerly been normal should

always awaken suspicion and lead to an examination. Hemorrhage after coitus is an initial symptom of great importance, and when occurring some time after the establishment of the menopause it is almost pathognomonic of malignant disease.

Pelvic pain is usually a late symptom, due to secondary parametritis; but intractable sciatica, developing after the menopause, is significant. When a patient with these symptoms applies to her physician she ought certainly to be examined, and if the portio does not present a suspicious appearance, search should be made for cancer higher up in the cervix or corpus uteri. Fragments should be removed for microscopical examination. Patients themselves are often to blame since they defer seeking professional advice until too late, because they have no severe pain, the irregular hemorrhages being attributed to the approaching change of life. It is a peculiar fact that women who have cancer are less likely to fear it than those who have not. In conclusion, the writer urges that both physicians and patients should be trained to recognize the initial symptoms of cancer of the uterus, and to have the diagnosis settled at once.

Pseudo-intraligamentous Ovarian Tumors.

Pawlik (*Centralblatt für Gynäkologie*, 1891, No. 38) reports seven cases which he thus characterizes. They are usually small ovarian tumors associated with diseased tubes, the disease being of puerperal or gonorrhœal origin. They develop posterior to the broad ligament, to which and to the mesovarium they contract firm, broad adhesions; they are also prone to adhere to the sigmoid flexure and to the bottom of Douglas's pouch. They become covered with pseudo-membranes which closely resemble peritoneum, so that they present the appearance of being actually intra-ligamentous. When the broad ligament is split for the purpose of enucleating the tumor, it will be seen that the latter lies behind the posterior fold. In removing these growths it is advisable to tie off the uterine end of the tube first, then to separate the adhesions from behind and below. By drawing the mass upward the adherent peritoneum forming Douglas's pouch will be elongated in such a way as to form a pedicle. Pressure may be advantageously exerted through the rectum by means of a colpeurynter. The writer prefers the latter method to operation in Trendelenburg's posture, since there is less danger of pus escaping among the intestines.

Localized Meteorism in Intestinal Obstruction.

Kader (Inaugural Dissertation: abstract in *Centralblatt für Gynäkologie*, 1891, No. 38) has conducted elaborate experiments on animals, his deductions being as follows: In every case of intestinal obstruction the portion of gut immediately above the point of obstruction becomes distended, but there is no marked increase in the distention in the course of twenty-four hours. When the obstruction is so complete that venous stasis is marked, serious tissue-changes occur in a few hours, which threaten the life of the subject; complete paralysis of the muscle is present and the meteorism is then strictly localized at the affected area, so that it may be readily recognized before the abdomen is opened.

Primary Cancer of the Vagina.

Hecht (Inaugural Dissertation: abstract in *Centralblatt für Gynäkologie*, 1891, No. 38) has made an exhaustive study of the literature of this subject. Among 4507 cases of cancer in females who were examined at the Vienna clinics in ten years he found only 50 cases of primary cancer of the vagina, or 1.1 per cent. It was most frequent between the ages of thirty and forty. Among the probable etiological factors were excessive childbearing and mechanical irritation, such as long-standing prolapsus and the wearing of pessaries. The disease appears under two forms—the cancroid and the diffuse scirrhous—and is usually located on the posterior wall. The initial symptoms are profuse leucorrhœa, which later becomes a foul watery discharge, and irregular hemorrhages during coitus and defecation. Later, pain and vesical symptoms appear. The portio and external genitals are involved late, if at all, but the lymph-glands are usually affected. Metastases are rare; among the whole number of cases analyzed there were only two of general carcinosis. Death is due to exhaustion. It is sometimes difficult to distinguish primary cancer of the vagina from disease originating in the portio; condyloma, sloughing fibrous polypus and sarcoma are distinguishable microscopically. The only treatment is radical removal with knife, scissors, or sharp spoon, followed by thorough cauterization. Cæsarean section has been performed on account of obstruction due to cancer of the vagina, but with bad results, only two patients having been saved out of twelve.

The Diagnosis of Non-puerperal Abscess of the Ovary.

Rheinstein (*Archiv für Gynäkologie*, Band xxxix., Heft 2) thinks that acute inflammation of the ovary is rarely observed outside of the puerperal state. The follicular form described by Slavjansky, which occurs in acute exanthemata, possesses rather an anatomical than a clinical interest. The interstitial form is very seldom encountered, except in the puerpera, when it is practically impossible to distinguish it from localized peritonitis.

Olshausen admits that a probable diagnosis can be made only when the enlarged ovary can be felt and the pain localized in it. The writer believes that it is only possible when the gradual enlargement of the affected gland has been traced from the outset by the finger of the observer, all other inflammatory conditions in the same region having been excluded. It is doubtful if a positive diagnosis can ever be made before the abdomen is opened.

The following illustrative case is cited: An unmarried woman, æt. twenty-three years, had aborted in June, 1888, and recovered without sequelæ. In November, 1889, she was sick with acute rheumatism for a month and had leucorrhœa, but no other local trouble. In February of the same year she had a chill and fever at the beginning of a menstrual period, accompanied with pain in the left side. The fever persisted, and the pain became so severe that she was often unable to go about. When admitted to the hospital she had an evening temperature of 101.6°; her abdomen was tense but not sensitive on pressure, with the exception of slight tenderness in the left iliac region. To the left of the uterus could be felt an intra-pelvic tumor, as large as an apple, perfectly movable, its consistence being generally hard, but

with soft spots. The diagnosis of suppurative disease of the right adnexa was made, laparotomy was performed, and a pus sac was found so firmly adherent to the intestines that a considerable portion of it was left behind. The patient made a good recovery. On microscopical examination of the specimen remains of ovarian stroma were found, but no traces of ovisacs. This fact, together with the location of the abscess behind the broad ligament, indicated its origin.

The history of the case seemed to point to pyosalpinx, but the latter condition does not, as a rule, develop so rapidly; moreover, the tumor was unilateral, which is seldom the case with pyosalpinx. On vaginal examination the mass was felt to be circumscribed, and could not be traced outward from the cornu uteri. The pain and fluctuation in the mass were not characteristic. As regards the etiology, it might be referred to gonorrhœal infection, the virus having perhaps entered a ruptured ovisac during or just after menstruation and caused an abscess of the ovary before there was time for the development of a corresponding pyosalpinx.

[The writer's review of the literature of the subject has been superficial, else he would not have overlooked a number of cases of non-puerperal ovarian abscess that have been reported at the New York Obstetrical Society, especially at a recent meeting. The condition is certainly not so rare as he states. We are surprised that he makes no reference to the differential diagnosis of abscess of the ovary and perityphlitic abscess—which is frequently impossible, especially when the suppurating ovary is buried in coils of intestine high up in the pelvis, so that it cannot be felt *per vaginam*, and when the sac ruptures into the gut. We have had two cases in which, after careful observation, laparotomy was performed for appendicitis and revealed the presence of ovarian abscess.—ED.]

PÆDIATRICS.

UNDER THE CHARGE OF

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THE USE OF STROPHANTHUS IN CHILDREN.

DEMME reports (*Jahrbuch f. Kinderheilk.*, xxxi., Nos. 1 and 2) that a 1 : 20 preparation of tincture of strophanthus produces a strengthening of the systolic contraction of the frog's heart somewhat less decided than is produced by digitalis. This effect can be sustained a long time by careful dosage, but as the dosage is increased the contractile force diminishes and gradually a cessation in systole results. The toxic effect of strophanthus on the heart-muscle may occur unexpectedly and more suddenly than with digitalis, hence the necessity of great caution in administering the drug to

children. Strophanthus also causes a prolongation of the diastole and a diminution in the frequency of the pulse as long as the energy of the systole increases. The author used the drug in seven cases of uncomplicated mitral disease, in five of scarlatinal nephritis, in three of exudative pleuritis, and in two each of bronchial asthma, pulmonary tuberculosis, and whooping-cough in children between five and fifteen years of age. Dyspepsia was produced in the younger children, so that the treatment could not be continued. The initial dose for children from five to ten years of age was one drop, three times daily; for older children, one drop, four times daily. After four to seven days the dose was increased to three drops four or five times daily. Nausea and cold-sweating indicated a suspension of the treatment and the administration of wine, cognac, or coffee. In heart-failure diuresis was increased after three or four days, the pulse becoming slower and stronger and the breathing easier. The dropsical phenomena became less marked. The diuretic effect ceased after three or four days in five of the cases of mitral disease, and compensation could be effected only by the combined action of strophanthus with digitalis. A prompt diuretic effect was produced by strophanthus in two of the cases of chronic scarlatinal nephritis, while in the acute cases no benefit was experienced. The effect in exudative pleuritis was satisfactory, and also in the two cases of bronchial asthma, in which strophanthus was given in connection with iodide of potassium. In pulmonary phthisis no positive result was observed, but in the two cases of whooping-cough, in which there was persistent dyspnœa and œdema of the lower extremities in consequence of dilatation of the heart, the results were satisfactory. The action of strophanthus consists in elevation of the blood-pressure and favorable influence upon the respiratory centre. It can complete the action of digitalis when both drugs are given, and neither cumulative effect nor diminished activity were observed in cases in which it was used during a long period.

Bronchiectasis in Young Children.

The subject of bronchiectasis receives but scanty notice in the ordinary works on children's diseases.

In the new Cyclopædia by Keating it is not even mentioned. In the recent text-book by Ashby and Wright it is dismissed in a few sentences as a complication of broncho-pneumonia. Henoch only briefly refers to it as an occasional result of chronic pneumonia. In Dr. Charles West's lectures it is merely incidentally mentioned under bronchitis. Goodheart says that it occurs mostly between five and nine years of age, and that bad pertussis frequently precedes it. Eustace Smith describes it under the head of "fibroid induration of the lung," but says that cirrhosis of the lung rarely attacks infants, and is usually found in children of five years old and upward; but J. Walter Carr (*The Practitioner*, London, 1891) records four cases whose ages are as follows: Five and three-quarters years, sixteen months, two years, eleven months.

Yet it is probable that bronchiectasis is by no means uncommon in childhood, though during life it is undoubtedly very apt to be overlooked, the case being regarded merely as one of bronchitis—with which it is usually coexistent—or, perhaps, in the later stages as one of phthisis. Moreover, the

supervention of bronchiectasis, though it seriously increases the gravity of the prognosis, does not, so far as we know, call for any important modification in treatment.

As regards etiology and pathology, the cases given illustrate fairly well the chief ways in which the disease may arise. It is, of course, always secondary to some antecedent lung trouble—bronchitis, pneumonia, or pleurisy. It is true that the acute specifics, especially measles and whooping-cough, are frequently its precursors.

We must remember that, whilst for convenience of description and of teaching we classify and describe bronchitis, collapse, broncho-pneumonia, lobar pneumonia, pleurisy, etc., in reality these conditions are generally intermixed—more so in children than in adults, and most of all in young children.

Some recorded cases, in which the bronchiectasis seems to have been congenital, were probably due to congenital atelectasis, the unexpanded pulmonary parenchyma having been gradually converted into fibrous tissue, which, subsequently contracting, caused a purely secondary bronchial dilatation.

The physical signs alone suggest, as a rule, a very rapid destruction of lung tissue. The most important points were the gradual supervention upon the ordinary evidences of bronchitis or broncho-pneumonia of distinct cavernous signs, with moderately loud gurgling and bubbling râles, and the variations from day to day in the number and character of these moist sounds. In some of the cases the variability in the physical signs, of course, pointed strongly to bronchial dilatation.

Bronchiectasis limited to part of one lung may be almost indistinguishable from a localized empyema; both are often preceded by a broncho-pneumonia. The loud, gurgling râles in the former condition may help in the diagnosis, but in many instances only the aspirating-needle will decide; and in such cases it may be well to remember the possible danger of penetrating a dilated bronchus, as was done in the second case of Carr.

The prognosis must necessarily be bad if the disease be at all extensive; but the cases show that it must be founded on the results of repeated physical examinations of the chest rather than on delusive hopes which may for a time be afforded by an improvement in the child's general condition. At the same time it is necessary to remember that the physical signs alone would seem to justify a far more immediately serious prognosis than experience shows to be correct.

A New Method of Dressing the Chest in Pneumonia, Pleurisy, Pleurodynia, etc.

William Hunt (*Annals of Gynecology and Pædiatry*, 1891) advises the following method to dress the chest in a case of pneumonia, pleurisy, pleurodynia, etc.:

Do it on a large scale, in the same way that we now dress abrasions, bruises, etc.

If there is to be any cupping or other preliminary operation, have that attended to; then all the ingredients wanting are pure collodion and absorbent cotton, in smooth layers, and a good broad brush, like a mucilage-brush.

Apply a very thin layer over the side affected, from spinal column to sternum, and secure it with collodion smeared thoroughly over it. Then go on with thicker layers, securing them with collodion until a good padding is obtained, paying particular attention to the edges. In double cases you can act accordingly. The advantages are:

1. The one dressing, if well applied, will last throughout the case; thus
2. The fatigue and discomfort of frequent poulticing are avoided.
3. The side, in single cases, is held as in a splint, while the free side does the breathing. A first-class non-conductor is covering the chest. It is possible that the contracting collodion may have some influence in controlling the blood-supply.
4. There is no particular interference, in one who has a good ear, with physical examination. May be it would be a good thing if there was; for having once made the diagnosis, what is the use of exhausting the patient every day by trying to find out whether one-eighth of an inch, more or less, is involved? The general symptoms will tell that.

Pleuritic Effusion in Children.

Herbert B. Whitney, in the *Denver Medical Times*, in reporting ten cases of latent serous effusion into the pleuræ of children aged respectively two and four years, remarks that there is little value in Smith's remarkable statement as to the variation in the line of flatness on change of posture. No such variation in the level of the fluid ever takes place in a pleuritic effusion at any age. It does occur in pneumo-hydrothorax, and possibly, also, in simple hydrothorax; but that books should still mention this as a sign of pleuritic effusion can only be explained by the well-known frequency with which errors of this sort are handed down from author to author. The laws which govern the shape and position assumed by a lung under pressure are difficult to determine, but one thing is certain: the lung does not simply float about on the surface of the fluid, nor do either lung or fluid readily alter their relative position. Whitney considers the curve of the upper line of flatness to be pathognomonic. This line has two varieties, according to the amount of effusion, the one being a simple curved line with upward convexity, and the other, more characteristic, the so-called "letter S" curve. This second variety of curve, which appears abruptly as soon as the effusion gets beyond a certain size, was first described by Garland, of Boston, as the "letter S" curve. The curve is found only in effusions of moderate extent; in a very large effusion the line becomes again a simple curve, but this time with upward concavity. This "letter S" curve, beginning at the sixth, seventh, or eighth dorsal vertebra, according to the amount of fluid, passes first outward, then upward, and is lost for a while in the upper axilla, or shoulder-joint; appearing again anteriorly, it either passes downward with a gradual slant to the base of the lung, or, in larger effusions, it passes more horizontally inward along one of the ribs to the sternum.

PUBLIC HEALTH.

UNDER THE CHARGE OF

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The Bacillus of Diphtheria.

Although the multiplicity of bacteria present in the "false membrane" of most cases of diphtheria has induced persons of a sceptical disposition, and not practically familiar with bacteriological manipulation, to question the existence of a specific pathogenic microbe in this disease, there can be no reasonable doubt as to the claims of that known as Klebs-Löffler's to this character, and such being the case its detection affords a ready and positive means of diagnosis in difficult cases. We have long insisted that diphtheria is a disease of far more frequent occurrence than many medical men are inclined to admit, and that not only should all, or nearly all, cases of so-called "membranous croup" and of deaths referred to croup be returned as laryngeal diphtheria, but that the great majority of tonsillites, pharyngites, and post-nasal catarrhs plainly originating in insanitary conditions are really diphtheritic, as is occasionally shown by the occurrence of unmistakable cases of diphtheria in families where such suspicious "sore-throats" have already been observed. We do not, however, deny that there are or may be sore-throats of septic origin which are not specific, or that a foul tonsillitis or pharyngitis of the simply catarrhal kind may, at times, assume a more alarming character than many cases of mild diphtheria; but considering the insidious course that the latter often exhibit, arousing no suspicion of danger until the fatal termination is imminent, and the fact that those which pass off favorably may be the means of communicating the infection in a virulent form to other and more susceptible subjects, a ready means of diagnosis—some pathognomonic symptom or characteristic phenomenon, if such could be found—would be of inestimable value to the physician.

Such, we are convinced, is to be obtained in the detection of the Klebs-Löffler bacillus, and we commend a careful perusal of the "Contributions to the Study of Diphtheria," by MM. E. Roux and A. Yersin in recent numbers of the *Annales de l'Institut Pasteur*. The method followed by these experimenters is to remove a fragment of the "false membrane" or exudation from the throat by a piece of cotton-wool held in a long forceps. This is then dried on blotting-paper and rubbed between microscopic glass covers, care being taken that the smear be produced by particles of the membrane itself and not by the salivary mucus and epithelium. The glasses, previously dried and passed through the flame of a spirit lamp, are stained, one by Löffler's blue, the other by gentian-violet after the method of Gram. The preparation, washed in water, is examined with a homogeneous immersion objective. The diphtheritic bacilli appear, among other microbes, in the

form of unequally stained slender rods, often grouped in masses, and with ends rounded, slightly curved, and pear- or club-shaped.

Instead of Löffler's blue, another composed of dahlia-violet and methyl-green may be used with advantage. One part of a one per cent. watery solution of the violet is to be mixed with three parts of a similar solution of the green, and enough distilled water then added to give a fine but not too dark a blue tint. This solution is very stable and does not deposit on standing. One drop is placed on a clean cover, which is to be immediately applied to another on which is the object to be stained. With either solution the specific bacilli take up the color sooner and more deeply than do the other microbes, and a little practice makes their recognition an easy matter.

In some typical cases the exudation is almost a pure culture of Löffler's bacillus, and it is always more abundant in portions of membrane taken from the pharynx than in those removed from the larynx after tracheotomy. In fœtid putrefying membranes the proportion of other microbes is greatest. The like predominance of saprophytes is observed as the case progresses toward recovery; and even at the commencement of the attack such a disparity between the numbers of specific and indifferent bacteria may justify a favorable prognosis.

Should any difficulty be experienced in discovering the bacilli, portions of the membrane may be hardened in alcohol and sections stained by Gram's method, when beneath the superficial layer, rich in common microbes, the specific bacilli will be seen in well-defined groups.

If the membrane be rapidly dried on linen or blotting-paper, its subsequent desiccation scarcely interferes with the staining process, so that the examination may be made by an expert on specimens sent through the post by medical men who have not the means of doing it themselves. But with a proper microscope and a little practice a few minutes is generally sufficient to obtain satisfactory evidence as to the nature of any given case.

For pure cultures, coagulated serum is by far the best medium, and in it sowings of the false membrane give rise to colonies of the specific bacillus within twenty-four hours, before saprophytes, or the streptococci always present in the exudation, have begun to grow.

This cultivation in gelatin-serum is, indeed, essential to an absolute diagnosis, for, as Dr. Klein has shown,[1] there are two forms of the Klebs-Löffler bacilli, which he calls Nos. 1 and 2, but which would be better described as two species of bacillus morphologically alike, though distinguishable by their behavior in gelatin cultures. No. 1 is not constantly present in diphtheria, and does not act pathogenetically on animals; in fact, is not the specific bacillus or cause of the disease, which the so-called No. 2 is. The pseudo-diphtheritic bacillus, or No. 1, grows freely enough in pure serum, but not on serum rendered solid by gelatin at temperatures of 70–72° F., which the true bacillus of diphtheria does. Hitherto no one seems to have been aware of the existence of the two forms, for Löffler himself and Flügge state that the bacillus does not grow in gelatin at temperatures below 76° F., while Zarniko and Escherich assert positively that it does so even below 72° F., clearly

[1] Report of Medical Officer of Local Government Board.

showing that while the latter experimented with the true one, the former made these observations on the false, though in his inoculations Löffler must have used the pathogenetic form.

According to Dr. Klein, the surest way to obtain pure cultures of the specific bacillus of diphtheria is to wash the pieces of membrane by shaking them up in three successive portions of sterilized solution of common salt, and from the particles in the last to sow plate cultivations on solid serum-gelatin.

The bacilli in diphtheria, as it occurs in the human subject, are confined to the false membrane and perhaps the subjacent tissue; at any rate, they are never found in the blood—a fact which suggests irresistibly that the phenomena, febrile, neurotic, etc., of the disease are caused by the absorption of ptomaines, toxines, or other matters produced by the bacilli, which themselves remain in the original site. This supposition is confirmed by the fact that when guinea-pigs or other animals are inoculated subcutaneously with pure cultures of the bacillus, sections of the tumor produced exhibit under the microscope appearances closely resembling those of the diphtheritic tissue from the human pharynx, but that, though the general phenomena of the disease, nephritis, etc., are induced, the bacilli cannot be found in the blood.

Klein has, however, detected them in the neighboring lymphatic vessels and glands, and has obtained pure cultures from these; but this very limited extension, which we do not doubt would be found to apply to the inflamed submaxillary glands in man, and would indeed seem inevitable, does not detract from the local character of the primary process, and though the usual mode of infection by inhalation or imbibition would, at first sight, seem to offer a ready explanation of this localization in the pharynx, larynx, or nares in man, Dr. Klein's remarkable observations on the cow point to some more occult causes varying with the peculiar constitution of the animal.

The occasional appearance of a similar false membrane on the vaginal or other mucous membranes, and on parts of the skin denuded by blisters, by abrasions, or eczema, and on the surface of wounds, would seem to be comparable to the experimental inoculations in animals.

The theory which attributes the general phenomena to toxines, is fully confirmed by further experiments of Roux and Yersin, who separated the bacilli and their chemical products from artificial cultivations, and by injection of the latter alone produced in guinea-pigs all the general effects of the disease without any local manifestations whatever.

Dr. Thursfield, Dr. Downes, and Mr. Shirley Murphy have recently reported cases in which cats had been ill, and in some instances died, from a disease of the respiratory organs, and children who had played with and nursed them had sickened soon after with diphtheria, and others in which cats had been affected in like manner after association with children suffering from diphtheria. In two instances, post-mortem examinations of the cats revealed, besides evidence of broncho-pneumonia, renal lesions identical with those observed in diphtheria.

Doubts have been expressed as to the identity of the natural diphtheria of cats with that of man, from the fact that, though artificial inoculation of the pharynx or nares may lead to local manifestations resembling those of

diphtheria in man, the natural disease in the cat is distinctly pulmonary. But no one now questions the identity of human and bovine tuberculosis, though the peculiar lesions presented by the pleura in Perlsucht were formerly urged as evidence to the contrary. This, however, is by no means the only instance of a specific and communicable disease producing different phenomena, "accidents" in the logical sense of the word, in different animals, and the experiments of Klein at the Brown Institute in the production of diphtheria in cats by the use of infected milk, have confirmed the suggestion that in that animal the lung is the chief seat of the morbid phenomena, while the same tendency to pulmonary localization was observed in other cats that were subsequently infected by association with these.

A far more important question from a standpoint of practical hygiene is the communicability of diphtheria by means of milk. That such a mode of propagating the disease is possible, has been amply proved by the history of numerous epidemics. The evidence, however, had hitherto been wholly circumstantial, though none the less conclusive. We mean that the questions had not been solved, whether the milk served merely as a vehicle, perhaps a cultivation fluid also, but merely as a vehicle for the conveyance of the poison from man to man, as from the milker or dealer to the consumer, or whether the cow herself were capable of contracting the disease and thus becoming an active intermediary. We are not aware of any observations on the effects of the milk of nursing mothers suffering from diphtheria, but it is quite conceivable that such milk, whether of woman or cow, would, by being impregnated with the toxines present in the blood, acquire highly poisonous properties. At the same time, the experiments of Roux and Yersin with the pure chemical products of artificial cultures, suggest by analogy that the disease induced by the use of such milk would, though resembling diphtheria in its general phenomena, be marked by the absence of the bacilli and of the local manifestations of their action on the pharyngeal mucous membrane. This would not be the case were the cow to be inoculated on her udders by the hands of an infected milker, and such a contingency is not improbable.

But Dr. Klein, having learnt that in one undoubted instance of the spread of diphtheria by means of milk, the cows at the inculpated dairy, though apparently in good health, had suffered from "chaps" on their udders, determined to investigate the whole question experimentally. He inoculated two cows with pure cultures from a case of human diphtheria, using a Pravaz syringe and selecting the subcutaneous tissue of the shoulder as a neutral or indifferent spot. A swelling appeared, attended by some febrile disturbance and loss of appetite, but it, as well as the general symptoms, subsided after the third day. Between the eighth and tenth days, they began to suffer from a slight cough, and they left off feeding on the twelfth and twenty-third days respectively. The former died on the fifteenth and the latter was killed on the twenty-fifth. In both, from the fifth to the eleventh days, in fact, during the interval of freedom from any evidence of general disease, a succession of papules appeared on the teats. These papules were followed by vesicles, changing into pustules and ultimately forming brown or black crusts, which fell off in the course of five to seven days, leaving dry healing sores. Some of the vesicles and pustules were one-half or three-fourths of an inch in

diameter, but the majority were not more than one-fourth or even one-eighth of an inch across.

The milk drawn from these cows on the fifth day, before even a single papule had made its appearance, was found to be so charged with the bacillus of diphtheria that thirty-two colonies free from any admixture of other bacteria were obtained in pure cultures from one cubic centimetre of milk. When the vesicles first appeared, their serous contents were examined and found to be swarming with the bacilli, as were those of the succeeding pustules up to the last.

These experiments, conducted with every antiseptic and other precaution, demonstrate unequivocally the fact that in the cow the localization of the bacterial phenomena of the disease tends to the udder, and that the milk contains the bacilli in enormous numbers, though the means by which they are conveyed from a distant inoculation are extremely difficult to conceive, and can only be explained by further observations. It may be that the bacilli are not restricted as in man and the rodents to the site or proximity of their entry. It was by some of this milk, taken before the formation of the papules and while the teats were to all appearances perfectly sound and healthy, having been unintentionally given to a couple of cats that the epidemic among those animals in the Institute was set up.

For the post-mortem appearances presented by the cows, as well as the cats, and other details, we must refer our readers to the report of the Medical Officer to the Local Government Board, 1888–89; we have here only space for so much of Dr. Klein's discoveries as directly bears on and proves the fact that the cow is susceptible of diphtheria, and that, while in seeming health, her milk may be charged with the specific bacillus and be an active medium for the communication of the disease to mankind.

Corrigendum.—The order of figures 3 and 4, pp. 381 and 383 of the October issue, has been erroneously reversed; the description of each figure applies to the other.

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